FAA Safety BRIEFING

November/December 2010

Your source for general aviation news and information

Handling Abnormal and Emergency Situations

Federal Aviation Administration

www.faa.gov/news/safety_briefing/

The November/December 2010 issue of FAA Safety Briefing *focuses on planning for the "unplanned" and outlines the tools and resources pilots need to handle abnormal and emergency situations. Articles provide tips on unusual attitude recovery, partial-power takeoffs, and understanding your aircraft's electrical system.*

Photo courtesy of Cessna

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Jumpseat

JOHN M. ALLEN
DIRECTOR, FLIGHT STANDARDS SERVICE

Standing Down for Safety

As I write this I am heading off to Wichita, Kan., for the Bombardier Safety Standdown. This is not my first standdown for aviation safety. My first was many moons ago when I was an Air Force instructor pilot at the former Williams AFB. I well remember those early standdowns. They provided this young pilot a valuable time to focus on safety, to be introspective, to recalibrate, as well as to get up to speed on the latest developments.

At the Bombardier event I will provide an FAA update. But, more importantly, I will also talk about professionalism. It is what FAA Administrator Randy Babbitt spoke passionately about at the previous Bombardier event. Professionalism has been one of the administrator's major themes since he took the FAA helm in June 2009.

Cockpit professionalism is also one of my major passions and has been so since I first climbed into an Air Force trainer. This passion stayed with me as I have endeavored over the years—as instructor, commander, and regulator—to instill professionalism in other pilots.

The administrator is absolutely right when he says FAA cannot regulate professionalism. But, what is he really talking about? Just what is professionalism?

Professionalism is attitude, discipline, and attention to detail. It starts with precision and meeting every requirement. Little things mean a lot to a pilot who is a professional. Am I flying on speed, at altitude, or on glide path? Have I double- and triple-checked my proposed flight path? Am I keeping situationally aware at least 10 miles ahead of the plane?

Pilots are not born as proficient professionals. They need to be taught. From the first lesson, we must teach pilots to think and analyze, to prioritize based on risk, and to always exercise discipline. We must approach every pilot start as if that individual could one day be called upon to land a large passenger jet in the Hudson River.

That means focusing on judgment. From the beginning, we must teach all components of aeronautical decision-making, including gathering all information on routing, weather, and equipment, and make sure every training opportunity is as effective as possible. And, from the beginning, we must focus on professionalism, whether or not the pilot will be flying for fun or for a living. Every instructor must foster a professional attitude.

In addition to the crucial role of instructors, professionalism is well served when experienced pilots take the time to impart knowledge and experience. We sell ourselves, and our entire flying community, short when we assume training stops in the classroom.

Professionalism means doing the right thing even when no one is looking.

To reinforce that we at the FAA "walk the talk," we will have our second FAA Safety Team Standdown on April 2, 2011. The theme is: "Stand Up to Error, Stand Down for Safety." The main Standdown will be held in Lakeland, Fla., in conjunction with the Sun 'n Fun International Fly-in and Expo.

In addition, the FAA Safety Team will be scheduling special safety events during the month of April all around the country.

You will hear more about the FAA Standdown and related events. If you have not already signed up for an account on the FAA Safety Team Web site—www.FAASafety.gov—you should do so today. You will find a wealth of safety information, updates on future safety seminars, and much more.

I will be at Sun 'n Fun standing down for safety in April. I look forward to seeing you there!

New Aircraft Registration Procedures Now in Effect

Did you know about one-third of today's 357,000 U.S.-registered aircraft have inaccurate records? In order to improve the integrity of the aircraft registration database, the FAA published a rule requiring aircraft owners to re-register their aircraft over the next three years, and renew on a three-year regular basis thereafter. Re-registration, renewal, and expiration will clear inactive aircraft from the database and is essential to safety, regulatory enforcement, and all levels of law enforcement.

How does the process work? Approximately six months before an aircraft's registration expires, the FAA Civil Aviation Registry will mail instructions to the owner using the mailing address of record. The notice will identify the expiration date and the three-month window during which application must be made. As an added convenience, owners may also re-register their aircraft and pay the $5 fee online.

Do You Have a Top 10 List?

If you were making a top 10 list of best ways to avoid abnormal/emergency situations (this issue's theme), what would be on it? Alternatively, tell us what you consider to be the most effective habits for handling abnormal or emergency situations that you haven't been able to avoid? We will publish the best suggestions in a future issue. Send comments to SafetyBriefing@faa.gov.

The first re-registration notices were sent on Oct. 1, 2010, for aircraft that were registered in March of any year. These aircraft have been assigned an expiration date of March 31, 2011. The owners of these aircraft must apply for re-registration between Nov. 1, 2010, and Jan. 31, 2011. For aircraft registrations issued on or after Oct. 1, 2010, the certificates will be good for three years with the expiration date clearly shown. A full chart of the aircraft re-registration schedule can found at: http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/.

If an aircraft registration certificate expires and is not re-registered, the aircraft is not authorized for flight. In addition, the cancellation of the N-number assigned to that aircraft will take place approximately 90 days after the expiration of an aircraft's registration. Upon cancellation, an N-number will be unavailable for assignment or reservation for five years.

No More Waiting for Line Up and Wait

On Sept. 30, 2010, the ATC instruction "taxi in position and hold" became history. You now hear "line up and wait" when ATC issues the instruction for a pilot to taxi onto a departure runway and wait for takeoff clearance. The phrase is used when takeoff clearance cannot immediately be issued, either because of traffic or other reasons.

Under the "line up and wait" phraseology, the controller will: State your call sign, state the departure runway, and state "line up and wait." The phrase "traffic holding in position" will still be used to advise other aircraft that traffic has been authorized to "line up and wait" on an active runway. Details on the change are available in the Aeronautical Informational Manual (AIM) and Pilot/Controller Glossary, both located under the Air Traffic section of www.faa.gov.

There is an interactive course on www.faasafety.gov called "Line Up and Wait – LUAW." The course also reviews the new requirement for explicit ATC instructions to cross any active, inactive, or closed runway, and reviews best practices for avoiding runway incursions.

Laser Incidents on the Rise

FAA reports a continued increase in the number of incidents involving unauthorized illumination of aircraft by lasers and cautions pilots to be on the alert. As of September 2010, FAA had received 1,903 reports of aircraft laser illumination events year-to-date in 2010, a 50 percent increase from the same period in 2009. Laser beams directed at aircraft have the potential to cause temporary adverse visual effects for pilots, including distraction, startle, glare, flash blindness, and/or afterimage. Pilots exposed to laser illumination should avoid direct eye contact and shield their eyes to the extent possible consistent with aircraft control and safety.

"Pilots should also report any such incident to ATC as soon as possible," says FAA Air Traffic Control Specialist Cornelius Moore. "This will ensure a rapid response from local law enforcement to locate the source of the laser."

Refer to FAA Advisory Circular 70-2 (www.faa.gov/regulations_policies/advisory_circulars/) for more information.

Shaping the Future Generation of Aerospace

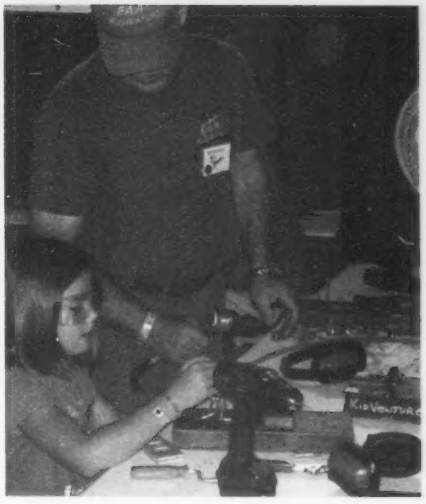
What better way to attract today's "virtual generation" than through an online youth aviation portal? As part of the Youth WINGS program, the FAASTeam unveiled a new Web site, www.FAASTeamYouth.org, at KidVenture during AirVenture 2010. The Web site's goal is to provide education resources for the next generation of aerospace industry workers and to encourage wider integration of aviation sciences.

"Our subject matter readily lends itself to K-12 programs and beyond through exercises and workshops that will provide a more interesting and practical foundation for science, technology, math, and engineering courses in our school systems," says FAASTeam Representative John Teipen.

During its AirVenture launch, more than 100 parents signed up their young aviator "wannabes" for the new site. Kevin Clover, National FAASTeam Manager, reports, "The meetings held during AirVenture with future sponsors and course or activity providers were overwhelmingly supportive."

Save the Date: April 2, 2011

Mark your calendars for April 2, 2011. This is the date of the second FAA Safety Team Standdown. This year's theme is "Stand Up to Error, Stand Down for Safety." The main Standdown will be held in Lakeland, Fla., in conjunction with the Sun 'n Fun International Fly-in and Expo. In addition, the FAA Safety Team will be scheduling special Standdown safety events around the country.



KidVenture gives children of all ages the opportunity to experience different facets of aviation.

Celebrate the History of Flight

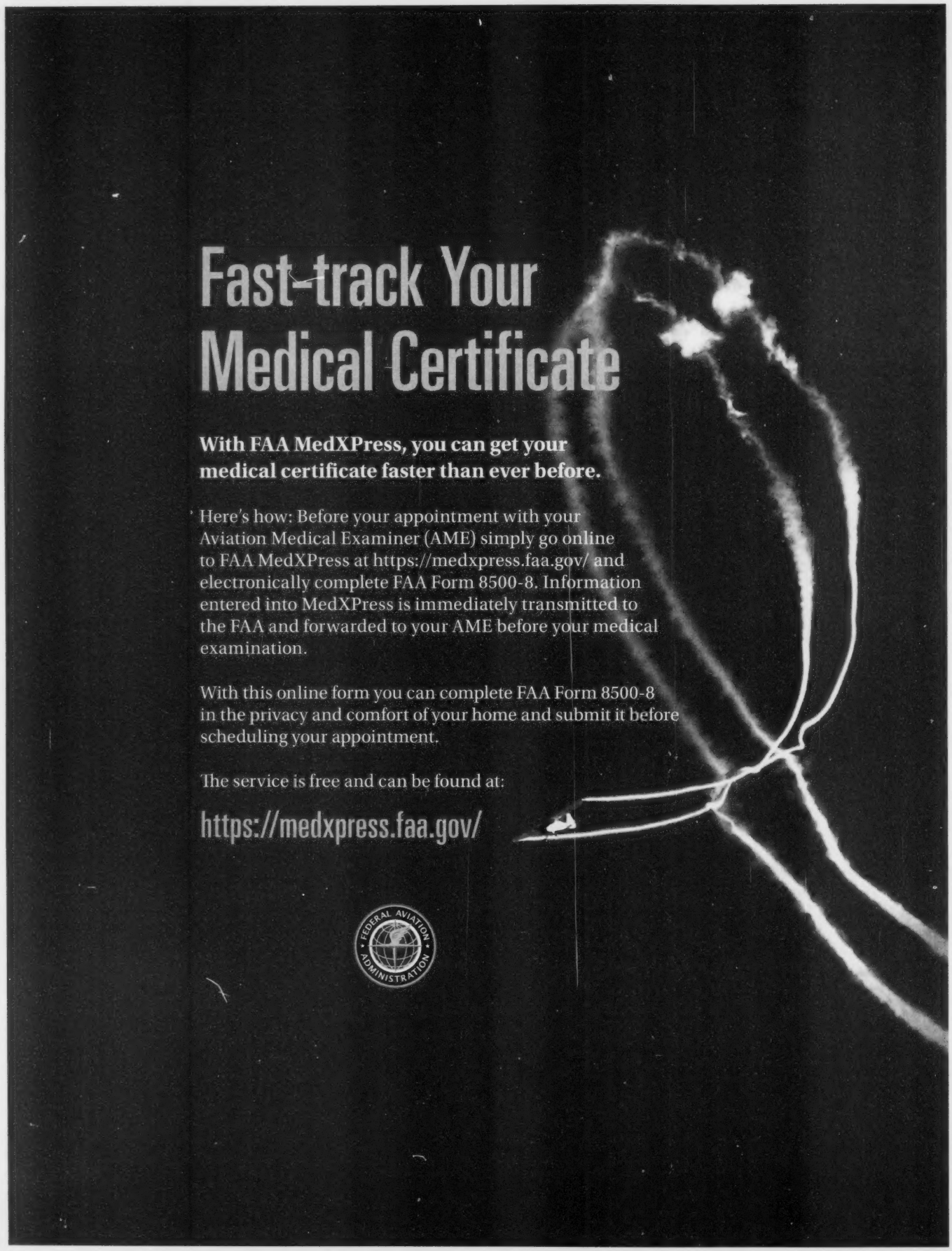
November is National Aviation History month and what better way to celebrate than to visit some of the country's best aviation museums and attractions. Some have scheduled special events to commemorate man's first steps in the science of aviation.

The Smithsonian Institution's National Air and Space Museum (www.nasm.si.edu) is one of the world's most-visited museums. On the West Coast is The Museum of Flight at Seattle's Boeing Field. Check it out at www.museumofflight.org.

If you plan to be in the Tucson, Ariz., area, visiting the Pima Air & Space Museum is a must. The museum boasts a collection of more than 300 aircraft, including some rare and one-of-a-kind displays. Pima Air & Space maintains its own aircraft restoration center and offers exclusive tours of the Aerospace Maintenance and Regeneration Group (AMARG), also known as the "Boneyard," located across the street at Davis-Monthan Air Force Base. Check it out at: http://www.pimaair.org/.

Wherever you may be this November, get out and celebrate aviation! You are likely to have a place nearby that can help you explore the exciting history of air transportation.

Tell us about your favorite aviation museum or attraction: SafetyBriefing@faa.gov.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FREDERICK E. TILTON, M.D.
FEDERAL AIR SURGEON

Aeromedical Advisory

Survival Skills

There was a time when aircraft accidents were most likely fatal. Though too many fatalities still occur, advances in aircraft technology have greatly increased survivability. Now, a crucial safety issue could be post-impact survival. As we saw in the Aug. 9, 2010, accident that killed former U.S. Senator Ted Stevens and four others, locating the wreckage and getting first responders on site took almost seven hours. Alaska has lots of remote terrain, but you don't have to be very far from a major city in the lower 48 to find that weather, terrain, or a number of other factors could delay rescue and leave you to fend for yourself and your passengers until help arrives.

It's All about Preparedness

What can you do? That's where the Office of Aerospace Medicine's Airman Education Program comes in with its specialized training and resources. A basic survival training course, conducted at the FAA's Civil Aerospace Medical Institute (CAMI) in Oklahoma City, Okla., covers survival in desert, arctic, and water environments. CAMI instructors provide two perspectives: how to prepare before the flight and the skills needed to endure environmental extremes.

The one-day course includes discussion of the psychology of survival, aircraft egress, search-and-rescue operations, signaling devices, fire starting/building, personal survival kits, rafts and accessories, and helicopter pickup devices. Better still, there is a hands-on portion that, depending on availability of personnel/equipment, may include a fire-starting lab, signaling lab, thermal (cold) chamber, ditching tank, underwater egress trainer, and an aircraft emergency evacuation (smoke) simulator. In short, the course gives general aviation pilots and their passengers a thorough grounding in preparing for survival both before and after an aircraft accident.

Know Thyself

CAMI also offers a class on aerospace physiology. This one-day training session includes such topics as physics of the atmosphere, respiration and circulation, decompression, stress, hypoxia, and hyperventilation, among others. In addition to the basic academic contents, this course offers practical demonstrations of rapid decompression (8,000 to 18,000 feet AGL) and hypoxia (25,000 feet AGL) using an altitude chamber. It also includes a demonstration of vertigo, using a spatial disorientation demonstrator.

Each year, CAMI offers more than 170 classes to more than 2,000 people. In addition, the Airman Education Program staff members are working to launch online courses based on the training materials. In the future, this will enable everyone to have access to the courses on www.FAASafety.gov and pilots will be able to get credit in the WINGS pilot proficiency program.

Advances in aircraft technology have greatly increased crash survivability, which means a crucial safety issue could be post-impact survival.

If you cannot make it to Oklahoma, you can still benefit from the information. The FAA has an online library of videos on survival training, aerospace physiology, human factors, and more at: www.faa.gov/pilots/training/airman_education/.

Lastly, one of the best things about all this training, whether in person or online, is that it is free. Whether you come to CAMI in person or visit the Web site, there are resources available. Check it out. You will be glad you did.

Frederick E. Tilton, M.D., M.P.H., received both an M.S. and a M.D. degree from the University of New Mexico and an M.P.H. from the University of Texas. During a 26-year career with the U.S. Air Force, Dr. Tilton logged more than 4,000 hours as a command pilot and senior flight surgeon flying a variety of aircraft. He currently flies the Cessna Citation 560 XL.

DR. WARREN S. SILBERMAN

Ask Medical Certification

Dr. Warren S. Silberman and his staff administer the aeromedical certification program for about 600,000 holders of U.S. pilot certificates and process 450,000 applications each year.

Q: I have recently undergone a laparoscopic robotic-assisted radical prostatectomy. The surgical pathology report shows the lymph nodes were clear of any malignancy and follow-up urological visits show a PSA, which was negligible. During my recent third-class medical, the examiner elected to defer my situation to the FAA. While my documentation from the urologist was not of the highest quality (he was on vacation), it stated that there is no need for subsequent chemo or radiation. Can you advise me as to the best method to clear this roadblock?

A: The FAA has accepted all forms of treatment for prostate cancer for Authorization for Special Issuance (waiver) consideration. Once an airman has one of the forms of treatment, he must consider himself grounded pending review by the Aeromedical Certification Division. FAA policy requires the airman wait at least six weeks until he provides the FAA with a waiver request. As for the specifics of your case, the FAA will need the operative and pathology reports from the procedure, a current status report from the treating urologist that addresses any complications and treatment, and a current PSA level. The FAA will then consider the waiver request. If you have not yet provided this medical information, please do so.

Send your question to SafetyBriefing@faa.gov. We'll forward it to Dr. Silberman without your name and publish the answer in an upcoming issue.

Q: Why was I denied a medical for atrial fibrillation?

A: Atrial fibrillation is a cardiac arrhythmia (irregular heart rhythm). Normally one's heartbeat originates from what is known as the sinus node, an area located in the atria, the heart's two upper chambers. An adult's average heart rate is about 51 to 99 beats per minute. A person who has atrial fibrillation has many beats originating throughout the atria and bombarding the heart's lower chambers roughly 250 times per minute. Not all of these beats get through because the heart must have a resting period, or what is called a refractory period, where it cannot discharge an electrical impulse and thus contract. The atrial chambers in someone with atrial fibrillation appear to contract irregularly, or fibrillate, much like a bowl of JELL-O®. This can result in the stagnation of blood since the chambers do not completely empty. This, in turn, can lead to clot formation and the clot(s) breaking loose resulting in what is known as an embolus. This embolus can cause a stroke. Thus, many people with atrial fibrillation require anticoagulant medication to prevent the body from forming clots. Here's a National Institute of Health Web site with more detail on atrial fibrillation:

http://www.nhlbi.nih.gov/health/dci/Diseases/af/af_what.html

There are many reasons why an airman could be denied for this condition, including:

1. The airman has been diagnosed with coronary artery disease, which has not been adequately treated.
2. The airman has been found to have a problem with a heart valve, which may result in other problems.
3. The atrial fibrillation heart rate is not adequately controlled.
4. The airman is not taking the proper anticoagulant.
5. The atrial fibrillation resulted in a stroke.

You need to ask the FAA why you were denied and what you need to do for reconsideration.

Warren S. Silberman, D.O., M.P.H., manager of FAA's Aerospace Medical Certification Division, joined FAA in 1997 after a career in the U.S. Army Medical Corps. Dr. Silberman is Board Certified in Internal Medical and Preventive/Aerospace Medicine. A private pilot with instrument and multi-engine ratings, he holds a third-class medical certificate.

SUSAN PARSON

When the Best Made Plans GO AWRY

Photo by Adrian Eichhorn

As any test pilot could tell you, the discipline of planning for both positive and adverse outcomes is one of the most essential elements in the mysterious mix that makes up the "right stuff" to be a pilot. The practice of planning is, accordingly, threaded through all aspects of aviation activity. Some of our planning, such as developing the information needed to file a flight plan and conducting a preflight inspection, is directed to ensure a normal outcome as we fly from airport A to airport B in a safe, legal, and expeditious manner.

The Scottish poet Robert Burns got it right when he wrote about the best made plans that can go awry. This is why we do contingency planning, such as reviewing emergency-action checklists and practicing engine-out landings and partial-panel approaches. This kind of planning is directed toward dealing with abnormal and emergency situations that we can readily imagine or anticipate.

Basic flight planning is about planning the flight in such a way as to ensure that it is perfectly normal and completely unremarkable.

But, as 19th-century Prussian general Helmuth von Moltke famously observed, even the best battle planning—essential though it is—rarely survives contact with the enemy. This is a wry acknowledgment that circumstances can sometimes produce challenges no one could have specifically planned to handle. The 1989 Flight 232 accident in Sioux City, Iowa, when a DC-10 lost all three hydraulic flight-control systems, provides a classic example of the curveballs that real life can throw at aircraft and pilots. That accident powerfully makes the point that pilots need to plan for the unplanned and have the tools necessary to handle scenarios considered too unlikely to merit a specific checklist.

Photo by James Williams

Planning for a Normal Outcome

This issue's theme is handling abnormal and emergency situations associated with mechanical malfunctions. As the saying goes, the superior pilot uses superior judgment to *avoid* abnormal or emergency situations that would require the exercise of superior piloting skills. That's what basic flight planning is about: planning all aspects of the flight in such a way to ensure that it is perfectly normal and completely unremarkable.

The first step, of course, is ensuring the aircraft you fly is legally airworthy, which means it conforms to its type certificate and all required maintenance and inspections have been accomplished. Bad things sometimes happen to machines between required maintenance and inspection events, so the purpose of preflight inspection is to make sure the aircraft meets another airworthiness requirement: Be in condition for safe flight.

Because many preflight inspections find nothing amiss, it is dangerously easy to become complacent and, in essence, phone in the performance of your preflight inspection. Tempting as that may be, it is a bad call. Your best chance of avoiding an abnormal or emergency situation in the air is to discover the condition that might cause it while you are safely on *terra firma*.

If the same old routine is contributing to a less than thorough preflight, here are suggestions for jazzing it up. First, approach each item with a "something's wrong" mentality, much as you would do in one of the preflight inspection contests you see at air shows. In a contest, you know someone has rigged the airplane with squawks and you look more carefully. Real life should be no different. In fact, the incentive to find the broken or missing parts is far greater than in a contest.

One technique is to consider reversing the order of your preflight inspection. If you normally start on the left side, try starting on the right. Or, if you normally start at the baggage door and move next to the empennage, try going next to the nose—stopping, of course, to inspect the areas in between. Because it is less familiar, this technique will force you to pay closer attention than you normally might. Two cautions: Always use the checklist to be sure you have covered all necessary items and do not use this technique if mechanical considerations dictate

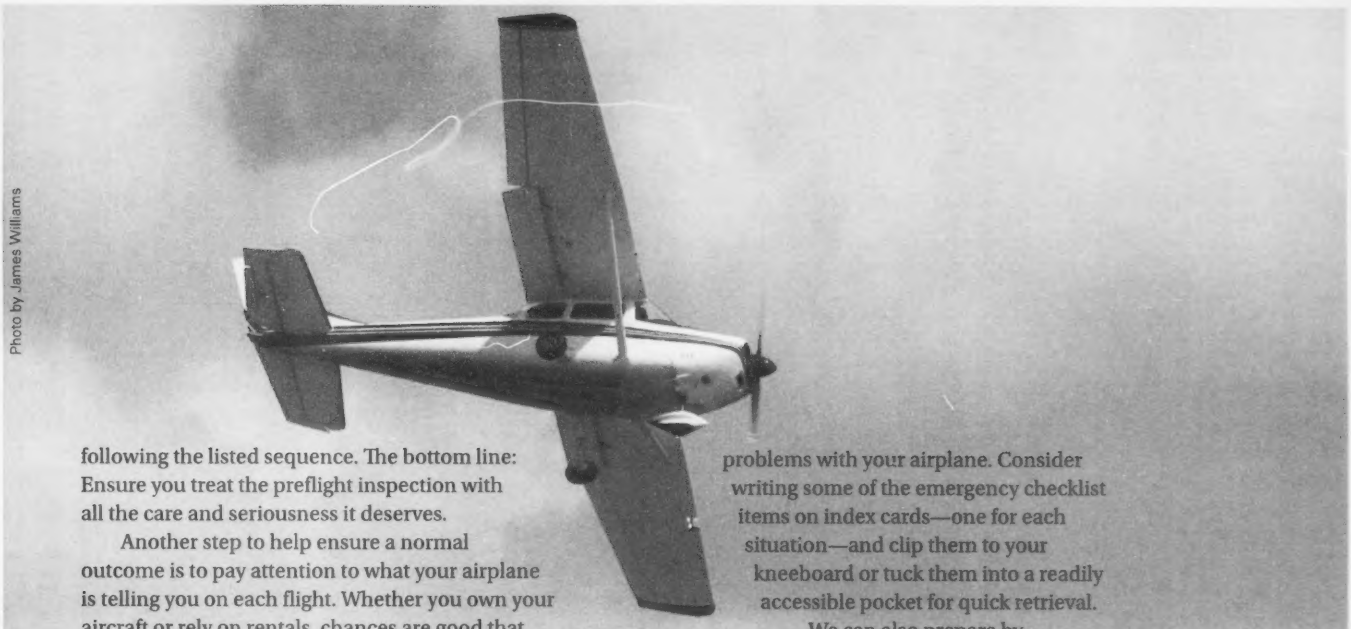

Photo by James Williams

following the listed sequence. The bottom line: Ensure you treat the preflight inspection with all the care and seriousness it deserves.

Another step to help ensure a normal outcome is to pay attention to what your airplane is telling you on each flight. Whether you own your aircraft or rely on rentals, chances are good that you see the same equipment regularly. If you make a point to watch and note the various engine and system indications for each aircraft you fly, it will not take long for you to develop a good sense of what is normal. When you see indications outside those familiar parameters—even if they are still within the manufacturer's acceptable limits—it is time to start asking questions about why they changed.

Today's pilots have a huge advantage in terms of the many approved engine and system-monitoring devices available. These gadgets easily pay for themselves by helping you spot away-from-normal trends at the earliest possible stage. Early detection of the abnormal offers the best chance of avoiding an emergency situation that could eventually develop.

Planning for Abnormal and Emergency Situations

Even if you have done everything you can possibly do to ensure a normal outcome, stuff happens. Engines fail. Vacuum pumps malfunction. These are abnormal or emergency situations common enough to have driven the development of situation-specific checklists. You will find these checklists in the emergency section of your Aircraft Flight Manual (AFM) or Pilot's Operating Handbook (POH).

The key to handling these abnormal or emergency situations is—you guessed it—planning and practice. Your flight instructor probably required you to memorize the three to five boldface items that typically lead each emergency or abnormal procedures checklist. Do you remember those items and review them regularly? If not, this is a good place to start in your planning and preparation for handling abnormal or emergency mechanical problems with your airplane. Consider writing some of the emergency checklist items on index cards—one for each situation—and clip them to your kneeboard or tuck them into a readily accessible pocket for quick retrieval.

We can also prepare by borrowing the visualization technique that world-class athletes use to get mentally prepared. Test your mastery of the abnormal and emergency procedures checklists by closing your eyes and visualizing the onset of the problem. Say out loud what you will do and then reach out and "touch" the control or instrument you have just mentioned. If you do not want to imagine it all, try this exercise while sitting in your airplane.

Simulation is another great tool for planning and preparing yourself to handle abnormal and emergency situations. It can be one of the best tools, since you can safely try things in the simulator that might create a real emergency if performed in an actual airplane. Today's flight-training devices for general aviation offer a tremendous range of possibilities. With the assistance of a qualified instructor, you can experience engine failures after takeoff and see why the 180-degree turn (though tempting) is usually not a safe option. You can see for yourself how subtle a vacuum failure can be in a conventionally-instrumented aircraft or experience primary flight display (PFD) and/or multi-function display (MFD) failures in a simulated glass-cockpit aircraft. Your instructor can also give you practice with electrical failures, control-system malfunctions, and more.

The right stuff includes solid training, regular practice, and the discipline to strive for proficiency and perfection on every flight.

"Do not try this at home" is a familiar warning, but there are some things you *can* try at home in this area. Flight simulation software can let you practice handling a variety of malfunctions and failures. Indeed, most of these programs will allow

you to set up random failures during a flight and let you experience them much as you would in real-world flying. One of the biggest benefits of such practice is the ability to experience both sudden and subtle failures, become familiar with their early indications, and practice overcoming the natural human tendency toward denial ("this can't be happening to me") and rationalization ("it's probably just a gauge problem").

Finally, applications such as Google Earth™ offer a whole new world of opportunity for planning what to do in situations, such as an engine failure. By "pre-flying" your planned route over the Google Earth map, you can acquaint yourself with terrain, obstacles, city layouts, and, in case you need them, suitable off-field landing sites.

Planning for the Unplanned

Now you know how to plan for a normal outcome and how to prepare for certain kinds of routine abnormal and emergency situations. Yet, what, if anything, can you do to prepare for what we'll call Sioux City events, or those failures and malfunctions considered so unlikely they are not addressed in the AFM/POH emergency procedures section?

These are the times when all the other "right stuff" elements come into play. When circumstances conspire to create a Sioux City event, there is no scrap of knowledge or skill that cannot be put to use in meeting the challenge. For a good pilot, the right stuff includes solid training, regular practice, and the discipline to strive for proficiency and perfection on every flight. It includes understanding your aircraft's systems—how they work, how they fail, and how those failures could affect other systems or controls. Know as much as you possibly can—then learn more.

The right stuff also includes mastery of crew resource management (CRM), which is relevant and applicable even if you are a crew of one. A pilot with good CRM skills is one who has strong situational awareness of the aircraft and its flight path, and also of the range of resources, e.g., air traffic control, that can assist. Finally, the right stuff includes planning, which can make all the difference between normal and abnormal or emergency situations.

Susan Parson is a special assistant in the FAA Flight Standards Service. She is an active general aviation pilot and flight instructor.

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Between a ROCK and a HARD SPOT

Handling a Partial-Power Takeoff

There is a lot of information and advice available about how to handle an engine failure. Though I am not minimizing its seriousness, a complete engine failure (especially if it occurs during cruise flight) does have some advantages. First, emergency approach and landing after a complete engine failure is a skill we learn early in flight training and then practice throughout our flying careers. Second, there are well-established checklists for handling an engine-out emergency. Third, and I learned this from the experience I am about to describe, a complete engine failure has the advantage of simplifying decision-making. Assuming that the restart checklist has not produced the desired effect, your priorities are to fly the airplane, choose the best available landing spot you can reach, and land under control at the slowest possible airspeed.

As I discovered a few summers ago, it can get a lot more complicated when you discover that the engine is producing partial power after takeoff, especially when flying from an airport with trees rising at the departure end.

It All Seemed So Perfect

It was late August, one of the most beautiful days of the year. The temperatures were in the mid-70s, the air was smooth with light and variable winds on the ground, and the high pressure helped to create visibilities that do not get much better, especially in New England. My best friend and I flew up to visit a retired FAA safety program manager and his wife. We had a wonderful visit; I was thinking this had been my best day of the summer.

Driving back to the airport, we meandered on a dirt road through gentle hills and thick forest and suddenly emerged at the airport. The only real indication that we were at an airport was a windsock, a couple of hangars, and my parked Cessna *Cardinal* RG. Although the runway had been dirt for many years, it was now asphalt. It was not flat, but had a rolling contour similar to the end of a roller coaster ride.

The airport narrowed toward the departure end, with rising, wooded terrain on both sides and trees at both ends. I remember thinking that density altitude would not be an issue, given moderate

Photo by James Williams

temperatures, high pressure, dry air, and a field elevation of only 510 feet. The windsock indicated light winds at about 3 knots, favoring a departure to the southwest. The winds would not be much help, especially in clearing the trees, but it was better than having no wind.

Something's Not Right Here

After a thorough pre-flight inspection, we fired up the *Cardinal*. We completed an uneventful run-up and ran the before-takeoff checklists, then taxied to the end of the runway. I was flying from the right seat, which after so many years of flight instructing, is a natural and comfortable position. Holding the brakes, I applied full power and confirmed that we had the proper manifold pressure, RPM, and oil-pressure indications before I released the brakes. With maximum power still applied, I released the brakes and started the takeoff roll.

My best techniques were not enough to overcome the fact that we did not have the power—or the airspeed—to climb fast enough to clear the pine trees.

Watching to confirm that the airspeed indicator was alive, I saw the airspeed come up to 55 mph indicated airspeed. Then I noticed it drop back down to about 52 mph. I momentarily considered aborting the takeoff, but we were already about two-thirds down the runway and the possibility of not being able to stop before the end of the runway ran through my mind.

Why didn't I abort the takeoff at the first instant I had that thought?

As quickly as I had that thought, I saw the airspeed reach our rotation speed of 65 mph; I elected to continue the takeoff. After we rotated, I positioned the pitch attitude to achieve a best-angle speed (Vx) of 72 mph (slightly lower than the max gross Vx of 75 mph). My best efforts and techniques were not enough to overcome the fact that we did not have the power—or the airspeed—to climb fast enough to comfortably clear the pine trees whose tops we were rapidly approaching.

I did not have many options or much time to consider even the few I had. Remembering that lowering flaps can have a momentary balloon effect, I extended them another 10 degrees to help us over the tops.

Back Side of the Power Curve

The balloon maneuver got us over the initial stand of trees, but it was costly in energy and airspeed. With more trees just ahead, I quickly needed to increase both. But, with power already set at maximum and no way to repeat the balloon maneuver with flaps, there were even fewer options. Recognizing that retracting flaps would produce a settling effect, I had to eliminate some of the drag. I retracted the flaps back to the 10-degree setting, turned toward the lowest of the trees, and considered what to do about the still-extended landing gear. Gear in transition produces the worst climb rate, but I had no hope of achieving best climb with it extended. I opted to raise the gear.

Now, returning to airspeed. Here we were on the back side of the power curve with trees fast approaching. In case you've forgotten that concept, the back side of the power curve exists whenever there is insufficient power to overcome the induced drag created by high angles of attack. Continuing to increase pitch would result in the airplane sinking, rather than climbing, and could lead to a stall.

It was very clear the engine was not making enough power for us to climb. I would have to lower the pitch attitude to accelerate back to Vx, but we were still below even the lowest of the trees. I was truly between a rock and a hard spot: I could not increase pitch without stalling and losing control of the airplane. Although I knew that lowering pitch was the only way to gain the airspeed I needed, anything lower than my current pitch attitude would surely put us into the treetops.

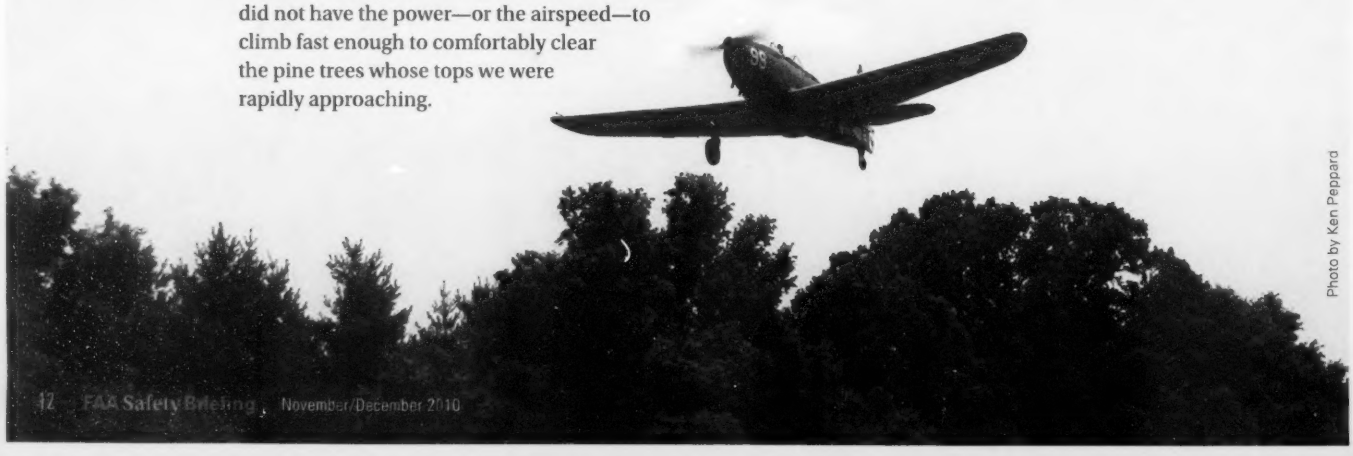

Photo by Ken Peppard

Hoping I could buy a few more feet and a little more time, I worked the pitch in an effort to keep us above both stall speed and the trees. The stall warning horn sounded intermittently. I thought we just might make it, but then the propeller hit a branch. The airplane yawed and banked to the right and then pitched down as we descended through branches and leaves.

When the airplane came to a stop, I found I had been thrown left to the limits of my seat and shoulder belts. My side of the cockpit was crushed in and offered no exit. My friend in the left seat was unconscious, so I released my seatbelt and managed to crawl across her to get to the door. Once outside the airplane, I was determining how to get her out when a firefighter appeared. He and a second firefighter quickly took charge.

Lessons Learned

We were both fortunate to make a full recovery from our injuries. For me, the physical recovery was the least of it; the bruises were also mental and emotional. I spent many a sleepless night going over and over the accident and the events that led up to it. I tend to be harsh on myself, but being harsh is how I continually strive to learn and improve as a pilot.

There were many unanswered questions. The most important one was: What could I, or should I, have done differently to avert this disaster? That question led to more: Why didn't I abort the takeoff at the first instant I had that thought? Why had I continued and lifted off as soon as we reached rotation speed? What was I thinking?

I knew there was an airspeed abnormality, which led to my early thoughts of aborting the takeoff. Like many pilots, I was more concerned about running off the end of the runway and damaging my airplane. But, it was almost game over. In the few seconds I had to consider the situation, I simply did not figure out the consequences of trying to climb out over trees with less than maximum power.

There was also a sense of complacency at work. I knew my airplane and the engine had been running well. There were no issues with density altitude. Weight and balance was not a concern. I was confident that my *Cardinal* would have no problems in clearing trees that stood more than 2,500 feet from the start of our takeoff roll. I was so confident, I saw no need to make the actual performance calculations.

As Easy As A-B-C

Emergency approaches were one of the hardest areas to master when I was learning to fly. I struggled to remember what to do first, fumbled around the sky looking for the best field, and constantly lost my place on the emergency checklist.

I eventually came across a simple ABC checklist for emergencies, which calls for an immediate focus on the most important tasks. Over the years, I added a few letters and developed the concept into a detailed outline for ground and flight training. It works. Even the most flustered flier can instantly recall the alphabet. The checklist is structured to stimulate recall of the right tasks in the right sequence.

Airspeed. Memorize best glide speed and try not to lose any altitude until reaching that speed. Once there, trim the aircraft for hands-off glide.

Best field. Note wind direction and strength, then current position. Are you directly over a suitable field now? Is there a suitable field at downwind position? Is there a suitable field at base or final position? Also, note present altitude relative to traffic pattern altitude, or 800 to 1,000 feet above ground level (AGL). Are you too high or too low? How can you fix it—flaps, extend, slips, S-turns?

Checklist. Start with a flow pattern across the panel. If altitude and circumstances permit, review the written restart checklist. Under all circumstances, it's more important to fly the airplane than to check the list.

Declare an emergency. Note current position and then tune the radio to 121.5 MHz, which should already be in the standby position. When making the mayday call, state who (tail number), what, where, and how many aboard. Set the transponder to 7700.

Exit preparation. Prepare the passengers for the landing. Ensure seatbelts are tightened, then brief passengers on exit procedures and assignments. Make sure the first aid/survival equipment is in a convenient place and prepare the aircraft, for example, cracking open doors, if the Pilot's Operating Handbook/Aircraft Flight Manual so directs.

Fire prevention. Shut the fuel off, along with the three Ms: mixture, mags, and master. Ensure the fire extinguisher is close at hand.

Ground plan. Touch down at the slowest possible airspeed, and then evacuate the aircraft. Account for everyone and use the first aid/survival equipment as needed.

— Susan Parson

Nevertheless, I had sensed something was amiss. It reminded me of Ernest Gann's *Fate is the Hunter* when the author notes:

> *... I already sense something is wrong. We are halfway down the runway and have only achieved sixty miles an hour ... Appreciation through habit is nearly instantaneous, but understanding is not. What the [expletive deleted] is wrong now? ... Yet all is apparently in order. These are the moments of truth in a pilot's life when he must decide within seconds whether he should abandon take-off and jump the brakes, or fully commit his airplane to flight.*

Gann made the same choice I did. He fully committed. He broke ground and lumbered out of ground effect only to realize that he would not clear a bigger obstruction than trees—the Taj Mahal—without non-standard action. And, just as I did in order to clear the first set of trees in my path, he deployed more flaps, which ballooned him to barely clear the spike of the first minaret and then the second.

Regardless of how many hours in your logbook, the learning never ends.

A Do-Over

In case you're wondering, check out chapter 13. Gann arrived at his destination to learn that, contrary to his fuel order, the tanks had been topped off. He was operating with 3 tons more weight than he had planned to carry. In my case, the NTSB determined that "the engine failed to produce sufficient power to climb for an undetermined reason."

Regardless of the engine's role, I know I played one. As is often the case after an accident, the FAA required me to take a re-certification check ride to the Commercial Pilot Practical Test Standards with emphasis on "performance and limitations; and short-field takeoff with maximum performance climb." In preparing for the oral portion of this exercise, I pored over my airplane's performance tables to calculate the performance I should have had on the day of the crash. Even with a fudge factor for a 30-year-old airframe, the book said I needed only 1,560 feet (including a 960-foot ground roll) to clear a 50-foot obstacle.

As I made these computations, I realized my major mistake. The first number you obtain from the performance charts is for the ground roll. How often, however, do we move on to consider whether there will be sufficient distance from the obstacle to clear it? Had I done the planning—with all the correct information relative to density altitude, wind, weight and balance, and runway surface and gradient—I would have known I needed 960 feet for the ground roll, with the rest needed to clear the obstacle.

In my case, the airspeed faltered at a point 200 feet beyond the 960 feet of ground-roll distance. Had I done the calculations, I would have known my only choice was to abort. That choice might have led to some damage to the airplane, but it would have kept an abnormal airspeed indication from developing into a life-threatening emergency.

Regardless of how many hours in your logbook, the learning never ends. Thankfully, I am alive to keep learning.

Doug Stewart is the 2004 National CFI of the Year, a Master CFI, and a DPE. He is also chair of the Society of Aviation and Flight Educators and operates DSFI, Inc. (www.dsflight.com), based at the Columbia County Airport (1B1) in Hudson, N.Y.

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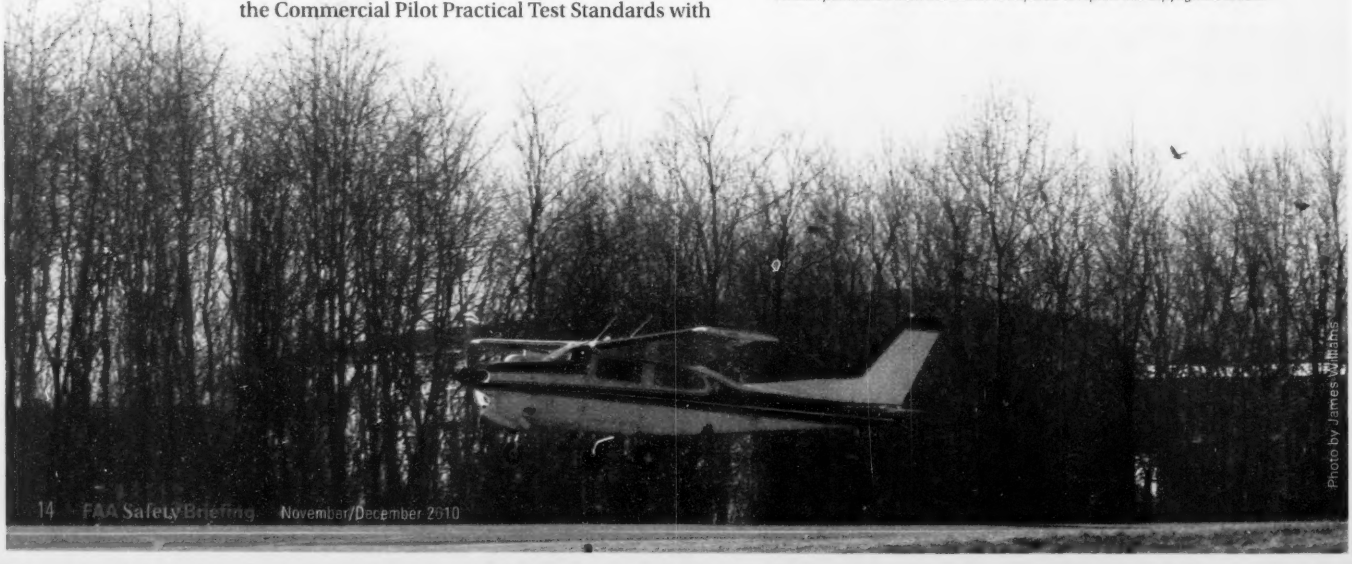
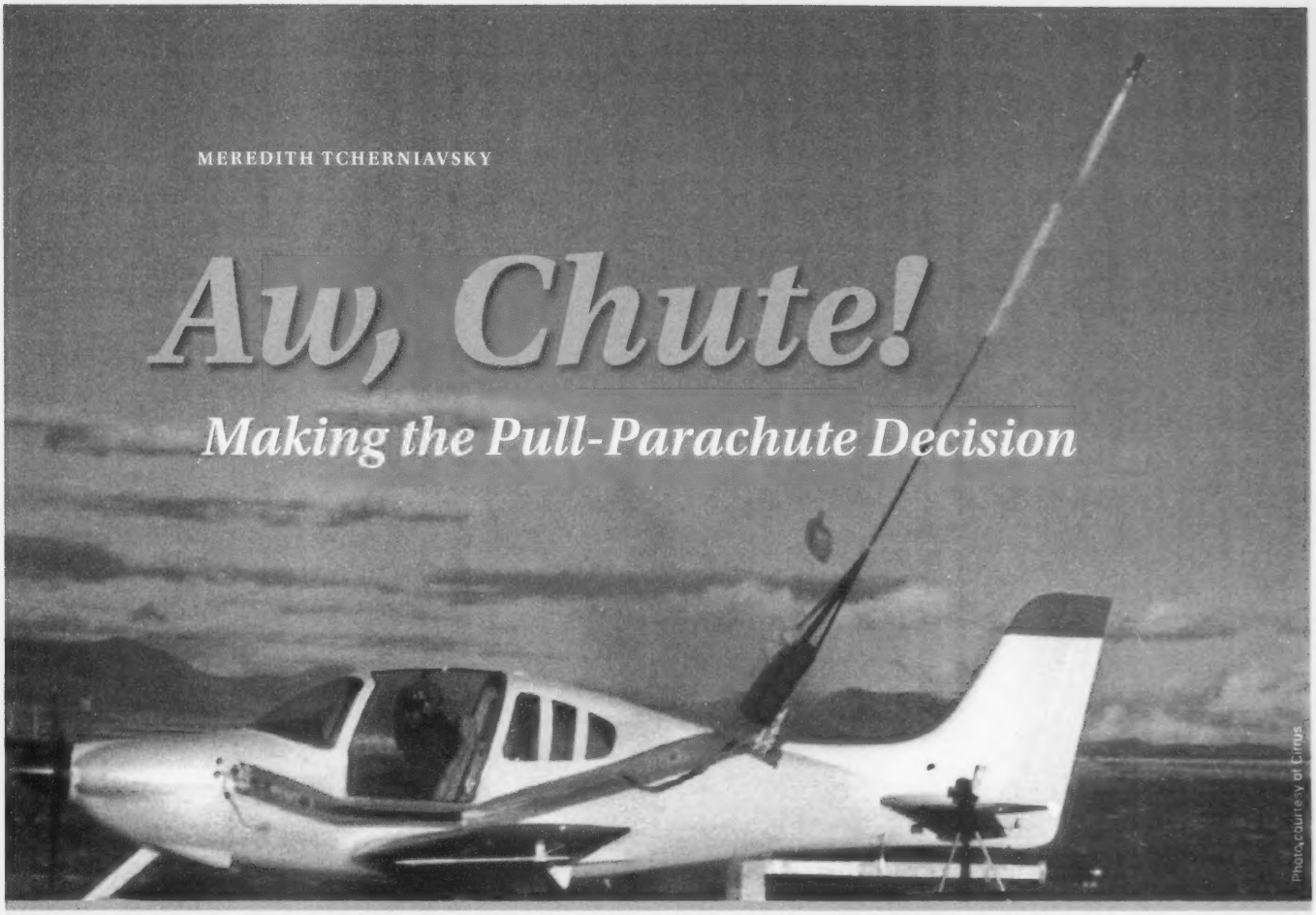


Photo by James Williams

MEREDITH TCHERNIAVSKY

Aw, Chute!

Making the Pull-Parachute Decision



Every pilot since the inception of powered flight more than a century ago has learned—and some learned the hard way—that if your single engine quits, you have no choice but to fly the airplane all the way to the ground. But, what if your airplane is equipped with an airframe parachute system that would greatly increase chances of survival for all onboard in the event of a catastrophic engine failure? Would you still attempt a forced landing and hope that your power-off short-field technique is up to the task?

For pilots who own or fly airplanes outfitted with an airframe parachute, the opportunity is there to deploy the parachute and allow the airplane to make a safe and steady descent toward the ground. However, pilots may struggle with the chute-pull decision, having learned through many hours of flight training that the instinctual response to an engine failure in a single-engine airplane is to trim for best glide speed and set up for a power-off approach to whatever suitable surface lies below.

This is why it is crucial to establish some criteria before you ever leave the ground for making the pull-or-land decision. The NTSB's accident data over the last 20 years suggests that off-airport landings have serious—and sometimes fatal—consequences. Recent data suggests, however, that deploying an airframe parachute, if one is available, increases the odds of survival, especially in situations where the pilot loses control of the airplane due to physical incapacitation or structural failure.

It's crucial to develop your own pull-or-land criteria before you leave the ground.

How an Airplane Packs a Parachute

While parachutes for light GA airplanes are proliferating, I have the greatest familiarity with those installed in Cirrus airplanes and will use this particular make and model as the basis for discussion in this article.

All airplanes manufactured by Cirrus are delivered with what is known as the Cirrus Airframe Parachute System, or CAPS. The parachute system's design and operation is fairly simple. A harness embedded in the aircraft's skin is attached to the fuselage and connected to a parachute located

Photo by Tom Hoffmann

inside the empennage. The parachute is extracted by a small rocket activated by pulling a handle inside the cockpit. In a few seconds the parachute opens. And, consistent with following the Pilot's Operating Handbook (POH) Emergency Procedures for CAPS Deployment, all forward velocity is gone, and the aircraft begins to descend under the canopy in a slightly nose-low attitude.

It's Not About Saving the Airplane!

Once the system is deployed, the aircraft occupants are essentially along for the ride. The flight controls will not have any effect and the aircraft will float in the direction of the prevailing wind. Altitude loss during deployment of the chute depends on a variety of factors. Although altitude losses of fewer than 400 feet have been demonstrated from level flight deployments, FAA aerospace engineer Wess Rouse notes, "Certain conditions may require considerably more altitude for the parachute to fully open, as covered in the Cirrus POH." Under canopy, the aircraft descent rate will stabilize, and according to the POH, "impact in a fully stabilized deployment is equivalent to a drop from approximately 13 feet."

You must have a clear understanding of the system's limitations as well as its benefits.

Interestingly, the POH for both the Cirrus SR20 and SR22 instructs pilots to establish best glide speed and maneuver for a forced landing if all attempts to restart the engine fail. Of CAPS, the Airplane and Systems Description section says: "The system is intended to save the lives of the occupants, but will most likely destroy the aircraft and may, in adverse circumstances, cause serious injury or death to the occupants."

Accordingly, it is important to carefully read the CAPS descriptions in Section 3, Emergency Procedures, and in Section 10, Safety, and consider when and how you would use the system. The emergency section states, "The Cirrus Airframe Parachute System (CAPS) should be activated in the event of a life-threatening emergency where CAPS deployment is determined to be safer than continued flight and landing."

You Are Still Pilot in Command

The fact that Cirrus leaves the CAPS deployment decision up to the pilot is consistent with the pilot in command's authority and responsibility outlined in Title 14 Code of Federal Regulations (14 CFR) part 91. However, the independent, not-for-profit Cirrus Owners and Pilots Association (COPA, of which the author is a member) takes a much stronger stance on the system's use. As COPA founder and president Rick Beach has stated at COPA safety seminars, "Way too many accident reports show that the pilot had the opportunity, the altitude, and the airspeed, but died without activating the parachute that has saved 70 lives in similar circumstances."

The pilot of a Cirrus SR22 that crashed approximately 2.5 miles west-northwest of Strom Field Airport in Morton, Wash., on March 19, 2010, may have wished he had done just that. According to the preliminary NTSB report, the private pilot was killed and the passenger sustained serious injuries after the pilot attempted to land the airplane following an engine failure in VFR conditions. According to a preliminary briefing by the NTSB, the pilot of another aircraft reported hearing a mayday call from the accident aircraft indicating that the Cirrus was "dead sticked and did not think he would make the airport."

The passenger of the accident airplane told the NTSB that the pilot suddenly placed his hands on the controls, told her the engine had lost power, and that they were going to land at a nearby airport. He entered a steep right turn toward the airport. The passenger could not recall hearing anything unusual. The passenger also indicated the pilot had discussed the CAPS with her prior to the trip and showed her how to activate it in the event of an emergency. The passenger reported that the pilot did not attempt to activate the CAPS.

After impacting trees, the airplane came to rest in a rural residential area on soft terrain used for gardening. Multiple fence posts and rails were dislodged and found at the main wreckage site. The wings and forward fuselage area sustained significant impact damage. All control surfaces remained attached. There was no fire.

Might the pilot have lived and his passenger spared serious injury if he had deployed the CAPS? It's impossible to know for sure, but another recent Cirrus engine failure ended successfully after the pilot chose to use the CAPS.

According to the NTSB's preliminary information, "the airplane was in level cruise flight at 11,000 feet when the engine lost power. The pilot tried to glide to the nearest airport, McCurtain County Regional. When he realized he would be unable to extend the glide, he deployed the ballistic parachute." The parachute opened properly "and ground impact caused substantial damage to the landing gear and wing."

Personal Minimums for Parachute Pull

What can we learn from these and other accidents? As with any aircraft, you need to know the system cold. If you fly an airplane that's equipped with a parachute system, that means having a clear understanding of its limitations as well as its benefits. For instance, remember that the parachute cannot help you if you experience an engine failure at an altitude too low for it to deploy, e.g., engine failure upon takeoff. For that reason, you should continue to practice simulated engine-out landings under safe conditions.

Think as well about the nature of the terrain you expect to traverse. Even with a parachute, a forced landing in rugged terrain or water will present challenges you need to consider and, as appropriate, mitigate. A pilot operating a parachute-equipped aircraft also needs to think a little differently about the implications of engine failure over a congested area. Though all pilots who lose engine power have somewhat limited options, remember that your ability to actively steer the aircraft, that is, direct it away from populated areas, disappears when you are under canopy.

There are no hard and fast textbook answers to these questions; on the contrary, much depends on the specific circumstances. Still, you will always be better off if your flight preparations have included a healthy dose of "what if" thinking and planning.

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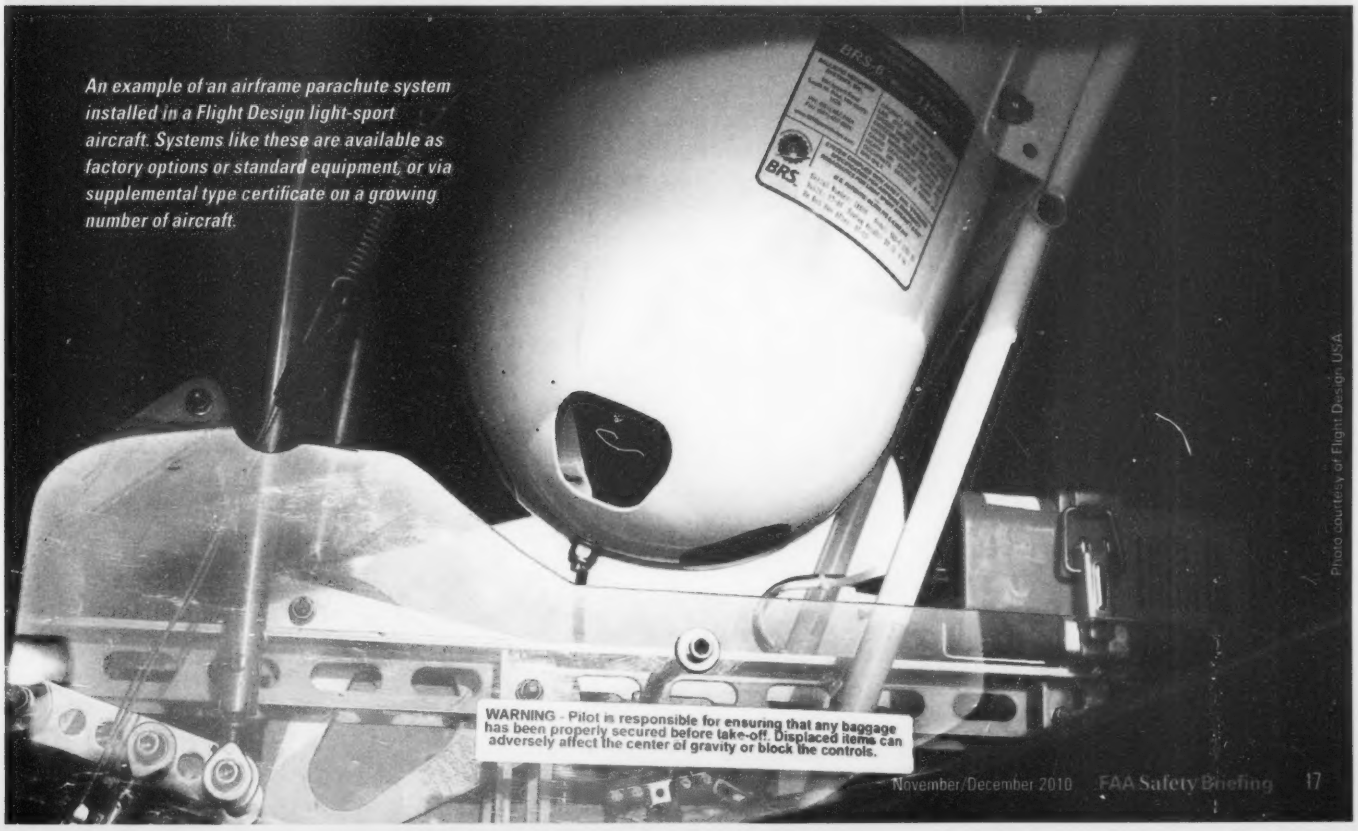
BRS
WARNING - Pilot is responsible for ensuring that any baggage has been properly secured before take-off. Displaced items can adversely affect the center of gravity or block the controls.

An example of an airframe parachute system installed in a Flight Design light-sport aircraft. Systems like these are available as factory options or standard equipment, or via supplemental type certificate on a growing number of aircraft.

Photo courtesy of Flight Design USA

SUSAN PARSON

Checklist

TEM-Work

No, that is not a typo. Teamwork in the form of crew resource management (CRM) is certainly important for both preventing and handling abnormal and emergency situations, but so is the concept of threat and error management (TEM). The TEM concept originated in the 1990s, when the University of Texas Human Factors Research Project and a major U.S. air carrier teamed up to evaluate CRM behavior in real-world operations. Through observations gained in these structured evaluations, called Line Operations Safety Audits (LOSA), the researchers became interested in threat and error management as an umbrella way of looking at human performance in the context of actual aviation operations.

Since human beings make mistakes and stuff happens, pilots must learn to manage threats and errors that compromise safety.

The Elements of TEM

Although the principles and practices of Aeronautical Decision Making, CRM, and the myriad regulations, policies, and procedures pilots follow are designed to prevent errors to the greatest possible extent, a key part of the TEM concept is that human beings still make mistakes, and stuff happens notwithstanding our best efforts. Since these threats and errors can create undesired states that undermine safety, TEM posits that pilots must learn to manage them.

A formal paper by Ashleigh Merritt and James Klinect, two of the University of Texas researchers, formally defines the three TEM elements as follows:

Threats are events or errors that (a) occur outside the influence of the flight crew, i.e., not caused by the crew; (b) increase the operational complexity of a flight; and (c) require crew attention and management in order to maintain safety margins. Threats can include mechanical malfunctions, bad weather, high terrain, or mistakes made by others.

Errors are flight-crew actions or inactions that (a) lead to a deviation from crew or organizational intentions or expectations; (b) reduce safety margins; and (c) increase the probability of adverse operational events on the ground or during flight. The researchers note that flight crew errors generally fall into one of three categories: aircraft handling mistakes; procedural errors, e.g., deviation from regulations or standard operating procedures; and communication errors.

Undesired state refers to a position, speed, attitude, or configuration of an aircraft that results from flight crew error, actions, or inaction and clearly reduces safety margins. The researchers concluded that the crew's ability to detect, identify, and manage (mitigate) the undesired state makes all the difference. On an unstable approach, for instance, a crew that recognizes the condition and takes prompt and proper corrective action can return the flight to a normal condition. If, however, the crew mismanages this condition, the undesired state could develop into an incident or accident.

Managing Threats and Errors

To manage threats and errors, the flight crew must constantly work to anticipate, recognize, and recover. Think of anticipation as Murphy's Law: If something can go wrong, it will. Anticipation leads to vigilance, which contributes to recognizing threats, errors, and undesired states in time to take corrective action. Recovery, of course, is the process of efficiently eliminating the undesired state.

The authors of TEM describe it as both a philosophy of safety and a practical set of techniques. Used as such, it can make you a better—and safer—pilot.

Susan Parson is a Special Assistant in the FAA's Flight Standards Service. She is an active general aviation pilot and flight instructor.

For More Information

Defensive Flying for Pilots: An Introduction to Threat and Error Management by Ashleigh Merritt, Ph.D. and James Klinect, Ph.D. (The University of Texas Human Factors Research Project - LOSA Collaborative) December 2006.
http://homepage.psy.utexas.edu/homepage/group/helmreichlab/publications/pubfiles/TEM.Paper.12.6.06.pdf

The Right Way Back to Right Side Up

WILL ALLEN

Photo by Tom Hoffmann

It's a beautiful day, and you are flying your single-engine general aviation airplane. Life is good. On approach to your destination airport, the controller issues a traffic advisory for the jetliner landing ahead of you and the standard "caution, wake turbulence" advisory. Rummaging through your mental filing cabinet, you fish out the file on techniques for avoiding wake. You think you are following the right procedures, and then—whoa! In the blink of an eye, your attitude whips from upbeat to upside down.

Scary stuff. But it doesn't have to be. Although any kind of aircraft upset close to the ground can be dangerous, a pilot whose logbook includes even a few hours of basic aerobatic instruction, including training on spin entries and recoveries, has a much better chance at completing a life-saving attitude adjustment. This is because pilots who have never seen brown on the up side and blue below are almost certain to react intuitively and try to pull up. Unfortunately, pulling up in such situations is a sure recipe for going down. A pilot who has had aerobatic training, on the other hand, will have the training and experience to properly right the airplane.

Opening the (Flight) Envelope

Your basic pilot training no doubt included steep turns, unusual attitudes, and stalls. These are among the building blocks of flight training, but they only scratch the surface of the attitudes an airplane can achieve in controlled flight with a pilot who knows how to maintain that control.

Aerobatic training can help you achieve the goal of control. This does not mean you have to learn to tumble an airplane or induce fighter-pilot level load factors ("Gs," as aerobatic pilots say) on your body. On the contrary, most of what you already know about unusual attitudes and upset recoveries can give you a sense of the range of possible attitudes. Even if you aren't interested in spending a lot of time flying upside down, you will have a lot more knowledge, skill, and confidence if you have experienced it and learned to recover from upsets and extreme unusual attitudes.

A pilot whose logbook includes a few hours of basic aerobatic instruction has a much better chance at successfully completing a life-saving attitude adjustment.

Doing the right thing in a timely way is extremely important if, as in our opening scenario, an unexpected wake turbulence encounter puts you in a bad attitude in close proximity to the ground. Learning to perform basic rolls and to recover from inverted flight will help you tremendously in such a situation.

The Spin on Spins

How about spins? Unless you are in an aircraft designed for spin entries and

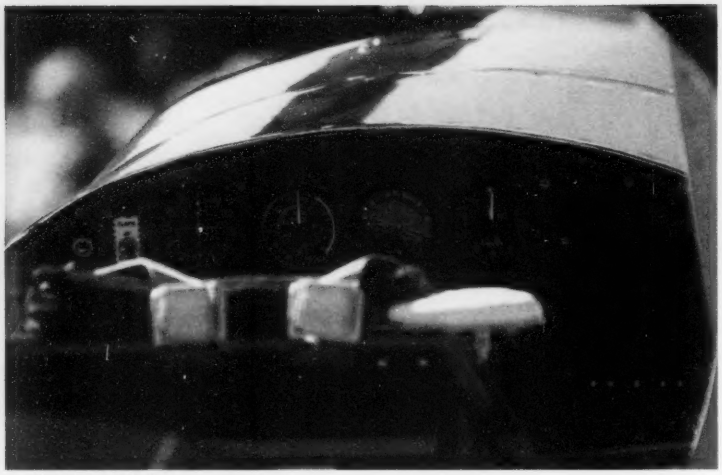

Photo by Tom Hoffmann

recoveries, and have been properly trained by a qualified instructor, you would probably agree that a spin qualifies as an abnormal or emergency situation.

You learned the recipe for spins in your initial pilot training. A full review of spin aerodynamics is beyond the scope of this article, but the basic ingredients for a spin are a stall and yaw that will then couple with roll and produce an autorotation around the spin axis. The aircraft follows a corkscrew path, and the pilot's absolutely natural instinct—to attempt a roll correction with aileron—is absolutely wrong. That's another reason you might want to consider basic aerobatic training that includes spin entries and recoveries.

Whether or not you take that route, it's a good idea to review spin recovery procedures on a regular basis. I cannot stress enough the importance of consulting the Pilot's Operating Handbook (POH) for spin recovery information for your particular airplane. In general, though, it helps to remember the PARE* approach. PARE is a fairly new acronym as a memory aid for the elements in NASA's standard spin recovery integrated with the most effective techniques.

- P = Power idle
- A = Ailerons neutral
- R = Rudder full opposite the spin
- E = Elevator forward through neutral

When rotation stops, neutralize the rudder and recover to a level attitude.

Right Airplane, Right Instructor

As with most skills, reading the directions and understanding the concepts is necessary, but not sufficient for mastery. Whether with rolls, loops, spins, or inverted flight, you have to do them to really learn and build the reflexes to automatically make the right actions in unusual and unexpected attitudes. Be sure, though, that you fly with a qualified instructor, and that you experience the extremes of flight in an airframe designed to handle the higher load factors imposed by aerobatic maneuvers.

Even the most basic aerobatic training will contribute to better control and greater confidence as a pilot.

Will Allen is a professional air show performer and FAA-certificated flight instructor who offers aerobatic and spin training in a Super Decathlon *through his company Flip Side Aerobatics (www.flipsideaerobatics.com), located in Seattle, Wash., and Tucson, Ariz.*

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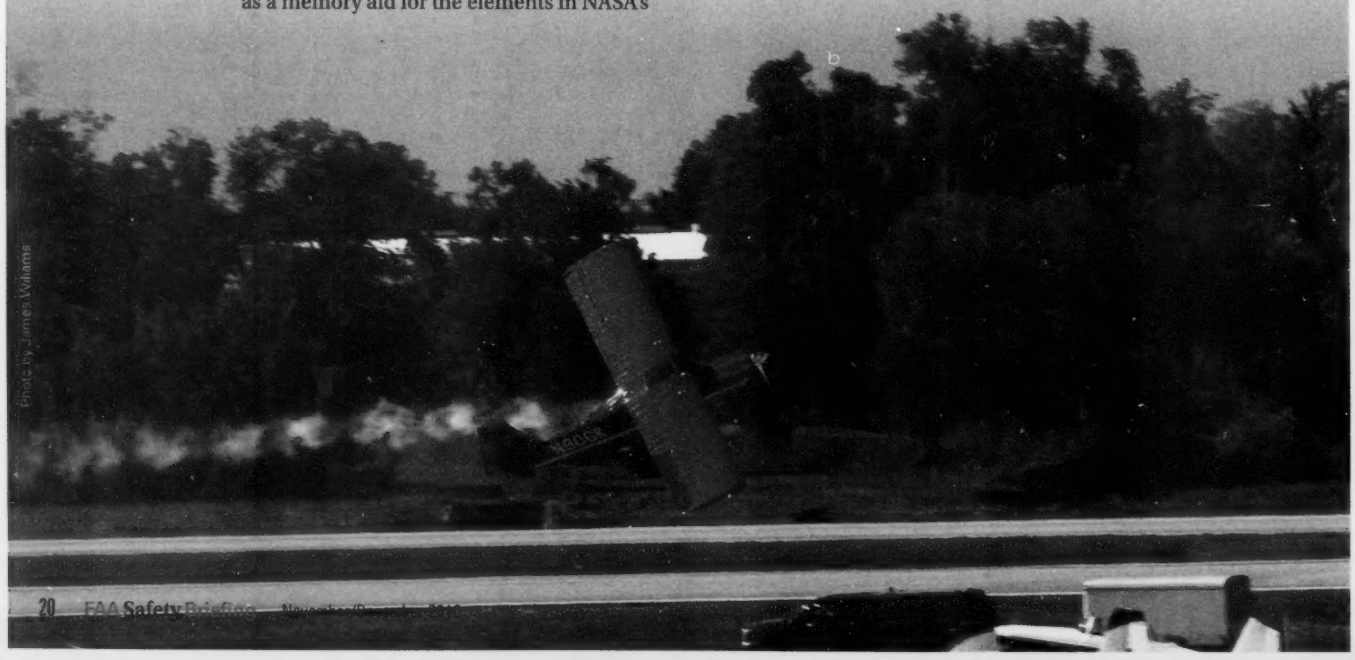

Photo by James Williams

MEL O. CINTRON

Vertically Speaking

Coming Soon ... to a Landing Pad near You

Helicopters save lives. That is a popular image of vertical flight—the helicopter emergency medical services (HEMS) team swooping in, hovering, recovering, and then flying to the hospital. But, helicopters also take lives. Sometimes it is in HEMS flights where lives are lost, but it is not the segment of the helicopter industry with the greatest number of accidents.

As Helicopter Association International (HAI) President Matt Zuccaro, who co-chairs the International Helicopter Safety Team (IHST) with the FAA, explains, "The segments of our industry with the highest accident rates are training and personal flying. Yet, HEMS accidents receive a large amount of press coverage.

"The industry segments with the highest proportion of accidents—training activities and personal flights conducted by private owners—do not receive similar media coverage," Zuccaro continues. "These areas have not received the attention they truly deserve."

The FAA, HAI, IHST, and others throughout the helicopter community are changing that. We've written before about the work being done to identify the leading causes of helicopter accidents and to develop targeted measures to address those causes. The Joint Helicopter Safety Analysis Team (JHSAT) is the IHST group that has been analyzing NTSB reports of U.S. helicopter accidents and cataloging the issues that, when combined, resulted in accidents.

As JHSAT team lead Jim Grigg explains, "Using an approach similar to Professor James Reason's 'Swiss-cheese' model of accident causation, we identified the holes that, when lined up, resulted in an accident. If any of the holes were not present, the accident may not have occurred." The holes, or Standard Problem Statements in the JHSAT vernacular, are ranked by their frequency.

After analyzing 523 U.S. helicopter accidents, here are the top ten Standard Problem Statements for helicopter safety:

1. *Pilot judgment/actions.* Flaws noted in procedure implementation, pilot decisions, landing procedure, flight profile, pilot/aircraft interface, or crew resource management.
2. *Data issues.* The investigator did not have access to a complete investigation and/or received inadequate information. (While arguably not a hole in the cheese, better investigations have greater potential to help identify problem areas and prevent future accidents.)
3. *Safety management.* The lack of (or inadequate) corporate safety management systems, failure to follow/enforce standard operating procedures, or disregard of a known safety risk, among other issues.
4. *Pilot situational awareness.* Pilot unaware of hazard proximity, weather, or aerodynamic state.
5. *Ground duties.* Includes lack of proper preflight inspections, mission planning, or passenger briefings.
6. *System/component failure.* A system or component failure of the helicopter, engine,

Photo by Tom Hoffmann

or special-mission equipment due to design or maintenance.

7. *Mission risk.* Operating on a mission with inherent risk, e.g., aerial application or firefighting, where low/slow or pilot-intensive flight is a necessary mission component.
8. *Maintenance.* The helicopter was released from maintenance in an unairworthy condition or there was non-compliance to the Instructions for Continued Airworthiness or airworthiness directives.
9. *Post-crash survival.* Cited in cases where technology, e.g., crashworthy fuel systems or emergency locator transmitters, could have mitigated the accident's severity.
10. *Regulatory.* Lack of regulatory oversight and/or insufficient regulations.

We will talk more about causes and interventions in upcoming columns. As for the leading cause—pilot judgment/actions—for one, this year the FAA Safety Team and HAI are co-leading an initiative to conduct regional helicopter safety seminars around the nation. Each seminar will have a session that focuses on operations unique to that region and a second session will focus on the highest-risk activities and target pilots, aviation maintenance technicians, and instructors. The seminars are complemented with training materials on www.FAASafety.gov as well as with focused resources through FAA's WINGS pilot proficiency program.

If you fly or maintain helicopters, check out: www.ihst.org.

Since there is such a wide range of uses, operators, and operating environments, improving helicopter safety requires a comprehensive approach. A crucial first step is working from facts and data—not perception. The essential next step is collaboratively working throughout the helicopter community to address the problem areas.

Mel O. Cintron, manager of FAA's General Aviation and Commercial Division, holds a commercial pilot certificate—rotorcraft/helicopter, airplane single-engine land with private pilot privileges—and an airframe and powerplant certificate with inspection authorization.

Keep Informed with

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Recent *Alerts* cover:

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- **Leaking dipstick housing on a Continental IO-550-C engine**

Check out *Aviation Maintenance Alerts* at:
http://www.faa.gov/aircraft/safety/alerts/aviation_maintenance/

DAVE SWARTZ

Why Should I Buy a 406 MHz ELT?

It was not a dark and stormy night, at least not yet.

That April day was a fairly typical day in south-central Alaska. Spring was in the air and the weather was nice, but winter in Alaska does not give up easily. That fateful morning, Richard (names have been changed) took off in an Astar helicopter with three telecommunications technicians on board for the short trip from Anchorage to several transmitters located on the hills around Anchorage, Palmer, and Wasilla. At the first stop, Richard dropped off George, one of the techs, and agreed to pick him up at about 1:00 p.m. The idea was to get in, do the job, and get out before an approaching storm.

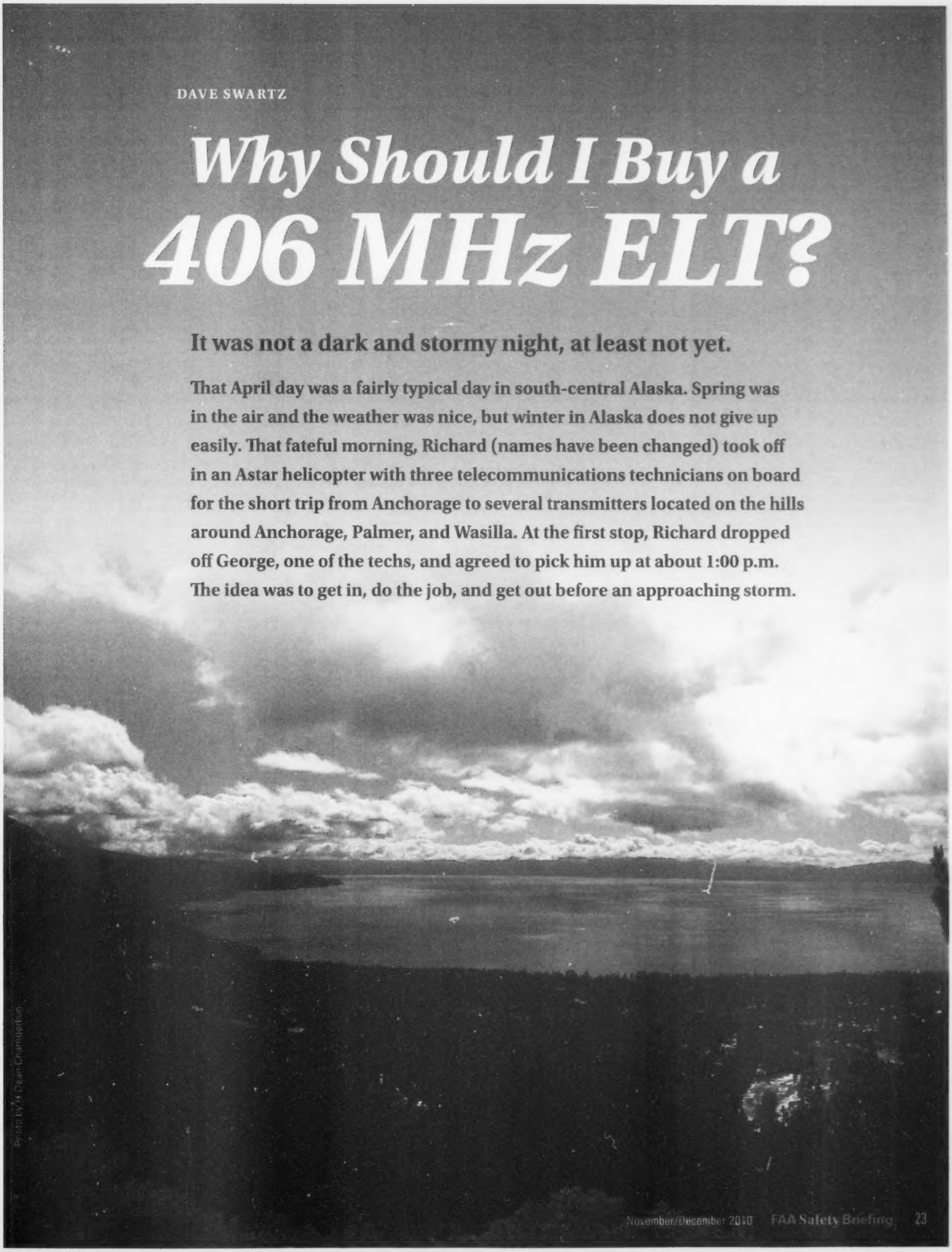


Photo by H. Dean Chamberlain

Another tech, John, had arranged to take his 15-year-old stepson, Jack, along. John and Jack met the helicopter at a rest stop along the Glenn Highway outside Palmer. Jack was excited to get to fly in a helicopter. He thought about how cool it was that a helicopter could fly sideways as the pilot picked the ship up and spun it around on its axis as they lifted off. The helicopter headed up the valley toward a communications site near the small town of Chickaloon in the Talkeetna Mountains. As they flew off, dark clouds were already visible on the horizon.

How to take the search out of search and rescue: 406 ELT plus GPS.

Meanwhile, about 50 miles southeast at Kulis Air Force Base, a Sikorsky HH-60 *Pave Hawk*, pride of the Alaska Air National Guard 210th Rescue Squadron, sat on the pad, fueled and ready to go. Thirty miles to the east, or about 20 minutes in a *Pave Hawk*, is the town of Palmer. The Mat-Su Medical Center has a well-equipped trauma center with 22 beds. It also has a helipad.

Accidents Happen

Most kids in Alaska are taught to be prepared; Jack was no exception. He had brought along a small backpack with lunch and two bottles of water. At 9:23 a.m., Jack dropped the backpack on the helicopter's fuel-control lever. No one had told him to be careful of the levers on the floor. A sudden surge of fuel entered the Turbomeca engine, and the turbine quickly began to overspeed. Within seconds, the engine hit 150 percent of its design speed and the turbine blades began to shed. The engine quickly lost power.

The pilot knew he was in trouble. The aircraft was in the so-called dead man's curve, too low and too slow for autorotation, but the pilot did what he could. He shouted, "Hold on! We are going to crash." Just before the Astar hit, he pulled collective and slowed the impact as much as possible, but they still hit hard. The helicopter went into a ravine; its fall arrested by some willow brush and about 4 feet of snow. After the helicopter came to rest, someone shouted for everyone to get out. At least one of the other adults was still alive.

Help Is (Not Yet) on the Way

This helicopter was equipped with an older emergency locator transmitter (ELT) that operates on the 121.5 MHz frequency instead of the new 406 MHz frequency. It also had a commercial satellite-based tracking system on board. At 9:30 that morning, the system sent a message to a computer at corporate headquarters that the aircraft was overdue. Unfortunately, no one was watching the screen.

At 11:21 a.m., two hours after the Astar hit the ravine, the SARSAT satellite (which was still monitoring 121.5 at that point) picked up an ELT signal from one of the old 121.5 ELTs. No one in the Rescue Coordination Center (RCC) knew of an overdue aircraft, so the duty crew followed procedure and began a telephone search. Because it was a 121.5 ELT, they didn't know whom to call. You see, a 121.5 ELT is not very smart. It does not transmit any identification information. All the RCC could do at that point was to call the troopers and see if they knew anything. They did not.

At 1:00 p.m., two things happened. The first was that George, the tech who had been dropped on the

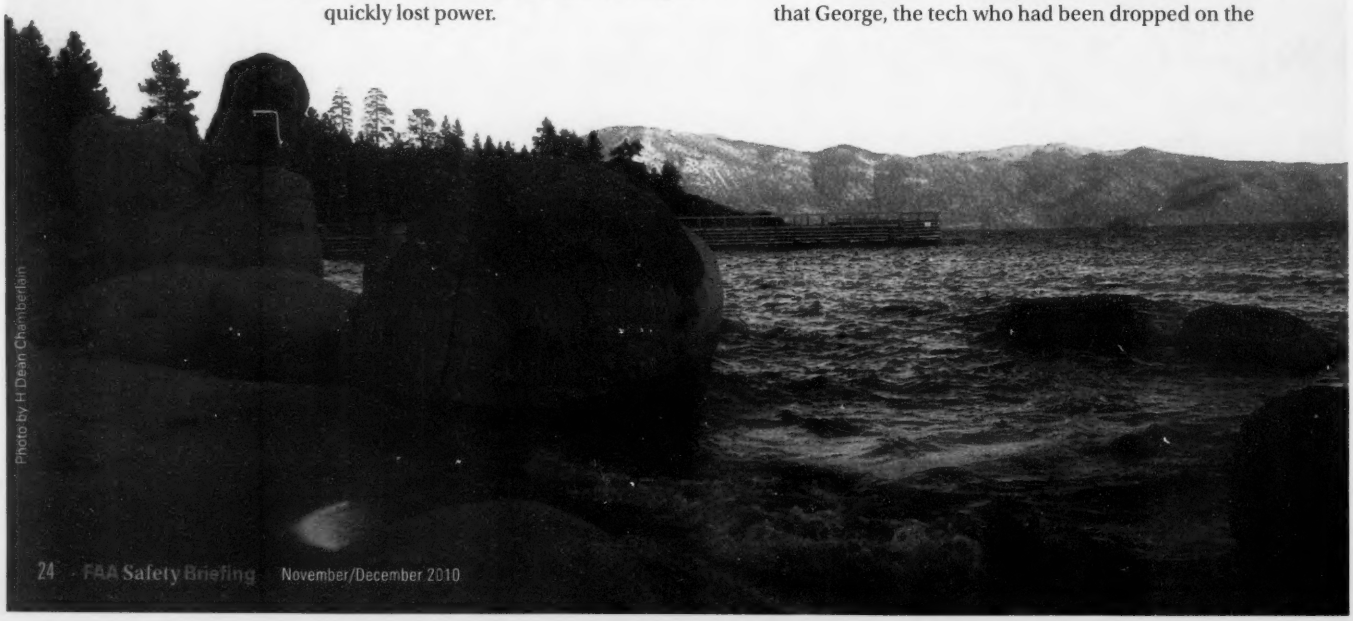


Photo by H Dean Chamberlain

mountaintop, began to get worried. He expected to be picked up at 1:00 p.m., but no helicopter was in sight and the weather was starting to close in. Being a tech-savvy guy with a lot of gear, he called the shop. They told him to sit tight and wait. By 2:00 p.m., George was worried enough to call the shop again. The shop started to try to raise the helicopter over the radio, with no answer. At 3:40 p.m., the shop placed the call that no one wants to make: They called the FAA and reported the helicopter overdue.

Needle in a Haystack

The second event at 1:00 p.m. was that the RCC decided to launch—only they had no idea where to send the *Pave Hawk*. In fact, the RCC still didn't know that there really was an aircraft down. After all, 121.5 ELTs have a large false-call rate; they can be triggered by things like microwave ovens. After the RCC received the overdue aircraft news that George's shop had provided, they had a general idea where to look, but still no specifics about where the crash site might be. The problem now was the weather.

The storm hit at 2:00 p.m. Visibility fell to between one and two miles in snow. The *Pave Hawk* tried to enter the valley two times where they thought the accident site might be; twice they were turned back by weather. Soon, the Civil Air Patrol and the Alaska State Troopers joined the search.

At the accident scene, Jack was scared. It was getting cold and the snow had begun to fall. Back on the mountaintop, George faced the fact that he was going to have a long cold night alone at the equipment shack.

As night fell, the searchers had to face the hard reality that continuing to fly in the mountains in the dark in a blizzard was tantamount to suicide. They were forced to return to base. By now, the ground searchers had the bit in their teeth and, despite the conditions, crews from Alaska Mountain Search and Rescue, the Alaska State Troopers, and the Air National Guard continued searching all night.

As dawn broke, the searchers threw everything they could into the air. The snow had subsided and at 7:50 a.m., a state trooper helicopter finally located the accident site. As the exhausted ground crews converged on the site, the trooper's observer noticed a young man wandering in the snow at the bottom of the ravine below the accident. The trooper pilot landed next to Jack and immediately flew him the short distance to the Mat-Su Medical Center in Palmer. Jack was incoherent and suffering from hypothermia, according to the troopers who saved him.

Unfortunately, Jack's stepdad John, the pilot Richard, and the other two techs had passed away by the time the troopers arrived. Jack could not remember what occurred that night, so we will never know exactly what happened. We do know that at least one person in addition to Jack survived the impact and, based on indications from seatbelts in the helicopter, another probably did as well.

A Different Outcome

Why do I tell you this story? It comes down to the 406 ELT. That same winter, another airplane had an incident in approximately the same area. In that case, the aircraft was equipped with a 406 ELT. Within 20 minutes after triggering the new 406 ELT, the pilot was aboard a *Pave Hawk*. Odds are that if Jack's helicopter had been equipped with a 406 ELT, rescuers would have been on scene in about the same amount of time instead of 22 hours. They may have been able to get the survivors to the trauma center during the golden hour for emergency medicine. With a 406 ELT, Richard, John, and the other two techs may have had a fighting chance.

Another benefit is that 406 ELTs transmit an electronic ID number.

What makes a 406 such a big improvement? First, SARSAT can locate a 406 ELT quickly and accurately. SARSAT no longer receives 121.5 ELTs, mostly because the system was flooded with false alarms. When 121.5 ELTs were still being received, it took two satellite passes and 45 to 90 minutes to get a lock. With the new GEOSAR satellite, though, the location lock time is down to one pass and about 5 minutes. Another difference is that 121.5 ELTs could only be located to within a 12 to 25 nautical-mile radius, so the search area was huge. Even without a GPS signal, the new 406 ELTs can locate you within 2 to 3 nautical miles and, with a GPS, that drops to within around 100 yards.

In other words, 406 ELT plus GPS takes the search out of search and rescue. All 406 ELTs come with a remote activation switch. In some cases, as with an in-flight fire or an engine failure, the satellites can locate you before impact. This helps because sometimes, even though the ELT may trigger, the antenna gets sheared off in the crash. It is conceivable that search and rescue might beat you to the accident site!

Another benefit is that 406 ELTs transmit an electronic ID number. This means that with a couple of phone calls, the false calls can be virtually eliminated. As a result, search and rescue can afford

to launch as soon as they get a confirmed 406 hit on SARSAT, usually within minutes. In practice, this means that as soon as the RCC gets a hit, they launch the rescue crews while they confirm it by calling the numbers on the ELT registration. This is usually complete before the blades start turning on the rescue chopper.

Finally, 406 ELTs have much more reliable G-switches and antennas. A review of the data shows 121.5 ELTs worked in only about 10 to 20 percent of crashes, while 406 ELTs are expected to work in 60 percent of crashes.

Can you afford to be without it?

We all know that cost is still an obstacle to buying a 406 ELT. Costs are coming down, but it is still an expense. The lowest price I have seen so far on a new 406 ELT was at an air show in 2008, where the price was $581, plus installation, battery, and antenna if needed. My local shop estimates the cost is between $2,000 and $2,200 for everything, including installation.

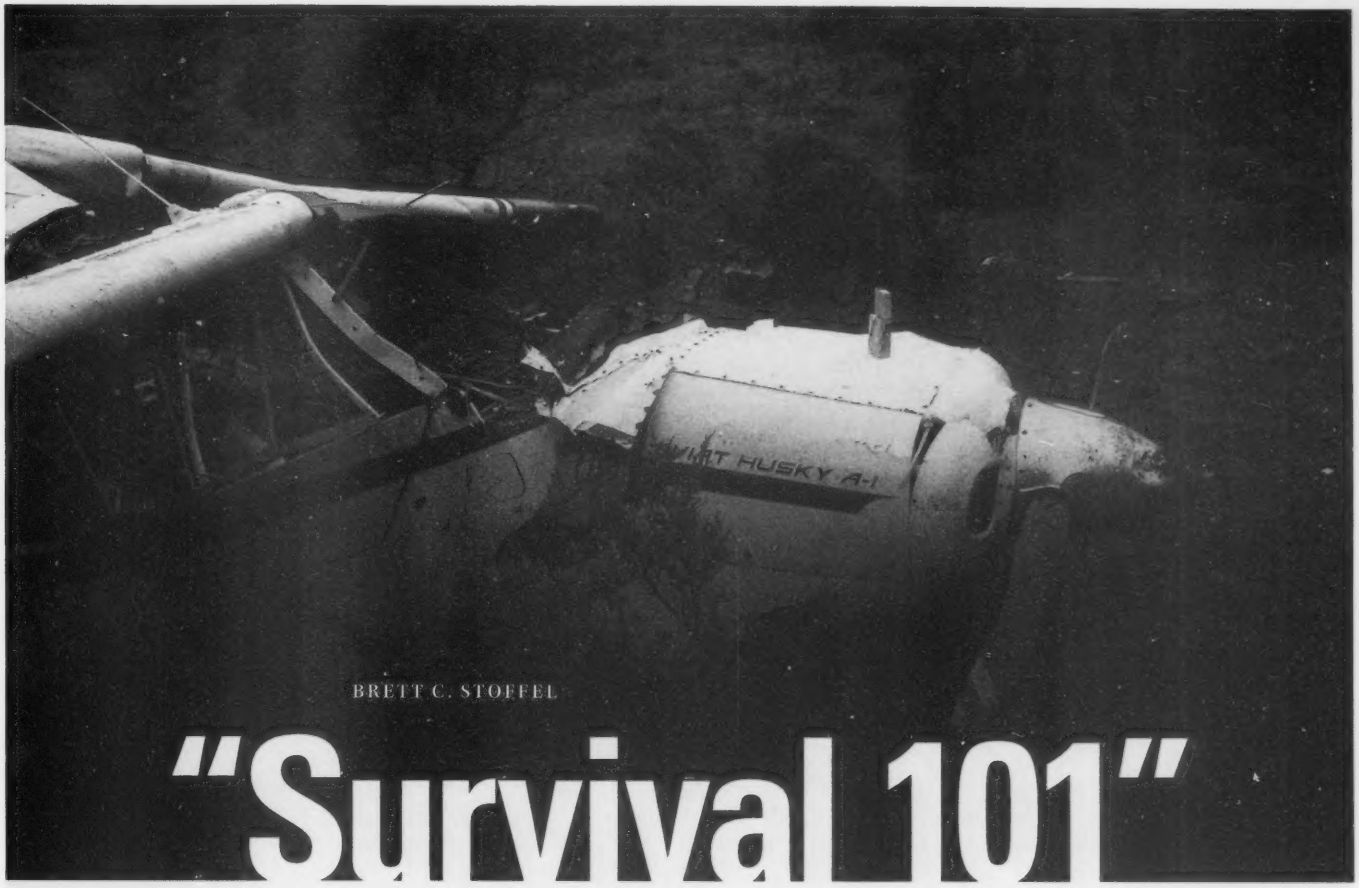
There are other technologies available, including the SPOT messenger and the Personal Locator Beacon (PLB). These have their place and, if you really can't afford a 406 ELT or if you fly a rental airplane with a 121.5 ELT only, I recommend one. Still, these devices do not compare to the 406 ELT.

It does make a difference. I recently led a team that reviewed fatal and serious injury accidents in Alaska. Our team looked at the causes of death and the nature of injuries to occupants. We reached the conclusion that in the last five years, a 406 ELT would have changed the outcome in about 12 percent of the fatal and serious injury accidents. Put another way, we had a shot at saving about 12 lives.

If you don't get a 406 ELT for yourself, I personally recommend that you get one for the people you fly with—your kids, your spouse, or your friends. If you don't get one, consider the lives you will put at risk searching for you if you go down. The same brave soldiers from the Alaska Air National Guard who searched for Jack also serve our country in the military around the world, including in Iraq and Afghanistan. They could use a break.

Dave Swartz, Ph.D., is a senior aerospace engineer at FAA's Anchorage Aircraft Certification Office. He holds private pilot land and sea ratings and likes to fly on skis. He is the proud owner of a 1949 Aeronca Sedan.

Photo by H Dean Chamberlain



BRETT C. STOFFEL

"Survival 101"

No one plans to have an accident. What you *can* plan for is how to survive an aviation emergency if you find yourself in that predicament.

Formula for Survival

While it is not magic, there is a formula that can help you focus on what you really need to stay alive after an emergency:

PMA + 98.6 = BCS

Positive Mental Attitude (PMA) plus 98.6 (the normal core-body temperature in Fahrenheit) equals the Best Chance for Survival (BCS). This simple formula captures a key idea: The proper attitude and the right focus on physiology give us the best chance at making it through a tough ordeal.

Let's start with PMA, or the psychology of survival. Peter Kummerfeldt, founder of OutdoorSafe, defines survival as "the ability and the desire to stay alive, all alone, under adverse conditions until rescued." Although Kummerfeldt's definition includes some of the physiological aspects, each has a psychological component. "Ability" implies skills that a prepared person has taken the time to learn. The survivor has total control over the "desire to stay alive." The combination of desire to stay alive and learned abilities contributes to the individual's capacity to endure, if necessary, "all alone" and "under adverse conditions until rescued."

An important part of PMA is the ability to channel fear into a useful direction. Uncontrolled fear can short-circuit rational behavior. But fear can also sharpen senses and prepare the body for "fight or flight." To use the natural fear reaction for good, think STOP: Stop what you are doing; Think about what causes your fear; Observe your surroundings objectively; and make a Plan to avoid danger.

Now, let's address what it takes to survive physically. In *The Essentials of Sea Survival*, Frank Golden, M.D., Ph.D., and Mike Tipton, Ph.D., stress the importance of understanding the body's needs as well as maintaining a thermal, hydration, and energy balance. The top priority is air, or more accurately, oxygen. High altitudes present a common reason for lack of oxygen. Smoke and fumes from a fire, or a water-filled cockpit after

As Federal Air Surgeon Frederick E. Tilton, M.D., discusses in this issue's Aeromedical Advisory column, FAA videos on survival training, aerospace physiology, and human factors are at: www.faa.gov/pilots/training/airman_education/.

ditching also present oxygen-critical situations.

Next in line is shelter, which is vital in protecting you from wind, cold temperatures, rain, sun, or cold water immersion. Clothing provides the first line of defense for shelter, followed by resources carried with you (including the remains of the aircraft), and anything in the environment. Since it is nearly impossible to improvise a windproof and waterproof shelter of purely natural materials, it's advisable to carry an immediate-action, full-body shelter.

Once you have taken care of air and shelter needs, you need to rest and conserve your energy resources. While resting, the body processes wastes, converts stored fats into energy, and allows the brain to recover some of its mental freshness.

Water and food complete the remaining two priorities. The amount of water required depends on conditions and activity, and can vary from 3 quarts a day in typical urban consumption to as much as several gallons in extremely hot and arid environments.

With respect to food, most of us could survive months without consuming any calories. The energy expended, and risks involved, in most food-gathering activities far outweigh any benefit gained. Consuming strange foods may even reduce chances for survival, since gastrointestinal illnesses can rapidly diminish the body's stored food and water resources.

Be Prepared

It is a good idea to stock a survival kit that can help you meet the body's basic requirements in an emergency. The survival kit should cover six basic categories: shelter, fire, signaling, medical, water disinfection/storage, and tools.

You might also consider basic survival training. Good courses include information on first aid, finding water, building shelter, making a fire, and improvising signal devices. Practice these skills at home or under controlled conditions. It also helps to maintain physical fitness.

Surviving an aircraft accident is rarely due to luck. By staying positive and properly prioritizing what the human body needs to survive, you will give yourself a much better chance to have stories to tell about survival in the wild.

Brett C. Stoffel is vice president and general counsel of Emergency Response International, Inc., which specializes in global survival, search and rescue, and emergency preparedness training. For more information, visit www.eri-online.com.

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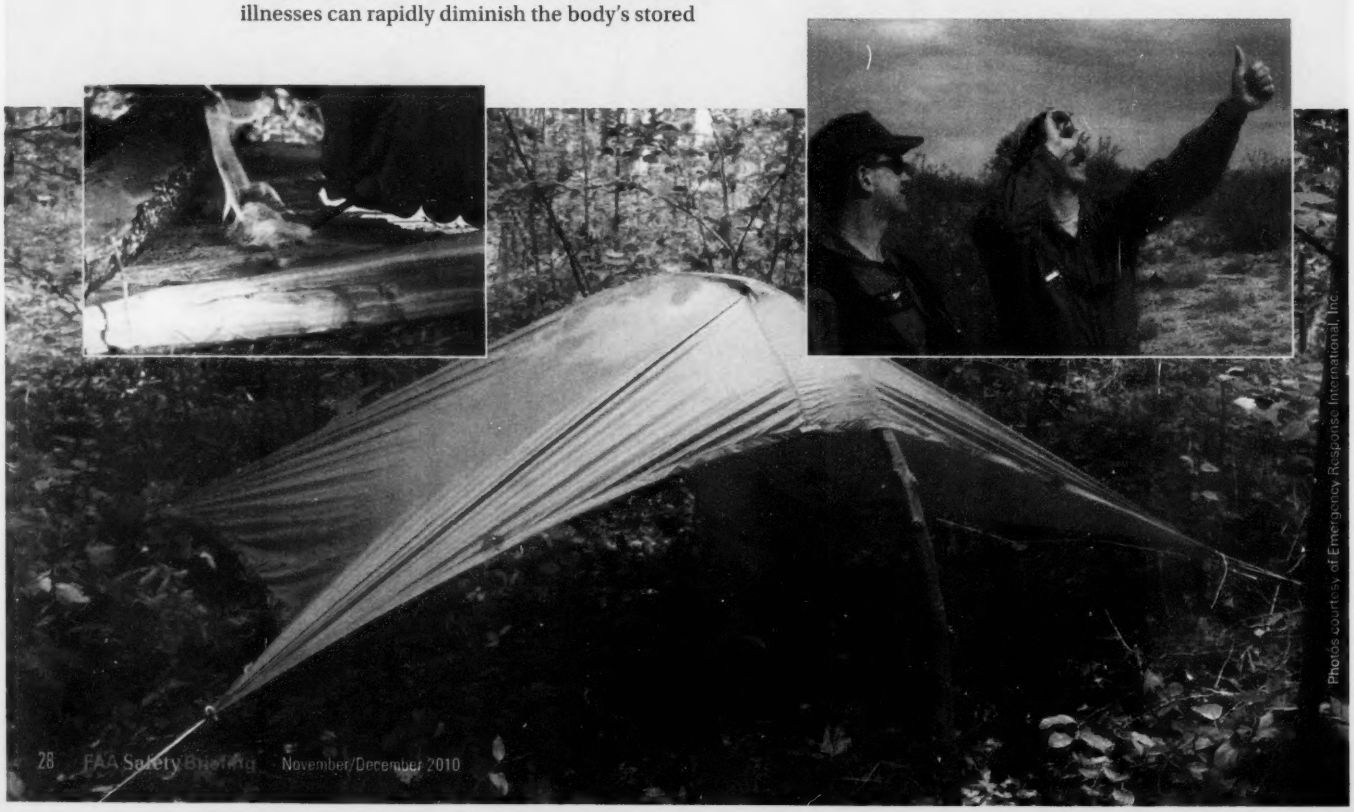


Photos courtesy of Emergency Response International, Inc.

PETER ROUSE

When the Lights Go Out

What you should know about aircraft electrical systems

There is an old aviation maintenance joke regarding electrical systems:

Q: What powers electrical boxes?

A: Magic smoke.

The explanation for the punch line is that once the magic smoke leaves the box, the box quits working. This joke is not to trivialize the importance of electrical systems on airplanes, but to humorously explain why there is a smell of charred insulation and a case of "interior IFR" when the "Whizbang 3000 integrated flight deck and food processor" decides to take a powder.

Where's the Plug?

Every powered airplane has an electrical system. Even the most basic powered airplane, the Piper *Cub*, for example, has an electrical system (its ignition system). There are wires, generators (magnetos), switches, and users of the electrical energy (spark plugs). This article addresses the electrical system that provides power for aircraft accessories, such as lights, avionics, motors, and actuators. Most of the airplanes we fly have at least an alternator or generator and a battery to provide power to the aircraft accessories.

The four primary components of an airplane's electrical system are:

- Aircraft bus
- Battery
- Alternator
- Voltage regulator

The aircraft bus serves as a central point to connect all of the electrical components. The bus is usually a simple bar of metal with holes drilled in it. The battery, which provides electrical power to the bus via electro-chemical reaction, is the primary power source when the engine is not running. The alternator provides electrical power to the bus by using the engine's power to spin a coil of wire on a rotor within another stationary coil of wire. The coil of wire on the rotor is referred to as the field; the stationary coil of wire is the stator. The rotor and field act as an electro-magnet and the spinning motion creates electricity within the stator.

The alternator is the primary source of power when the engine is running. The voltage regulator senses bus voltage and provides the proper amount of current to the field of the alternator to produce the desired amount of electricity in the stator.

Wiring Diagram

The three secondary components of an airplane's electrical system are:

- Wires
- Switches
- Circuit-protective devices (fuses or circuit breakers)

The wires are basic conductors, or pipes, that carry the electricity. The switches act as gates, or valves, that allow the flow of the electricity. The circuit-protective devices protect the wires from carrying too much electricity.

Why do we need switches? Switches control where the electricity is going, thus limiting the amount being used at any one time. Think of how high your electrical bill would be if every light in the house were always on. In the airplane, the electrical system is sized to provide all of the required power. However, every electrical component on the airplane does not have to operate continually. The switches also allow us to isolate the electrical components; we'll discuss why this is important later.

It pays to know what your electrical system looks like, how it functions, and what happens when it breaks.

Why do we need fuses or circuit breakers? When a wire carries electricity, a certain amount of heat is generated through the resistance of the wire. The more electricity a wire carries, the more heat is generated. Wires are sized based on the amount of electricity they have to carry. If a wire carries too much electricity, it can get hot and become a fire hazard. A fuse or circuit breaker is a switch that will open and prevent the flow of electricity when too much electricity flows through the wire.

The FAA released a Special Airworthiness Information Bulletin (SAIB) on circuit breakers: CE-10-11R1, Electrical: Fire Hazard in Resetting Circuit Breakers (C/Bs). I recommend that every pilot read this SAIB, which can be found at: www.faa.gov/aircraft/safety/alerts/SAIB/.

A Simple Electrical System Problem on the Ground

Let's look at an electrical system in a typical GA airplane equipped with avionics, flaps, pitot heat, a starter, and lights, such as a Cessna 172. See Fig. 1 for a picture of a typically equipped Cessna 172 electrical system.

The basic procedure to bring the electrical system to life is:

- Master (battery and alternator) switch on
- Starter on until the engine is running
- Radios and transponder on
- Flaps, pitot heat, and lights as needed

If everything is operating properly, the pilot has little more to do than to operate the systems normally. It is when things are not operating properly that some thought and investigation are necessary.

The first indication a pilot will usually have that electrons have died and gone to electron heaven is that the engine won't start. The diagnosis is fairly straightforward: The battery is dead (most likely reason); the starter has failed (second most likely reason); the battery relay (or switch) is not working; the starter relay (switch) is not working; or the circuit breakers have popped open.

The lack of battery charge is simple to fix: Either get ground power for a jump-start or get a battery charger and let the battery charge for a while. Bringing the starter and relays back to life is more involved and requires getting an A&P mechanic involved.

The beauty of all these problems is that they occurred on the ground, leaving the pilot with a variety of options. Even so, the airplane has just talked to the pilot. All the pilot has to do is understand what the airplane is saying. For translation assistance, a conversation with your local A&P mechanic is a good idea.

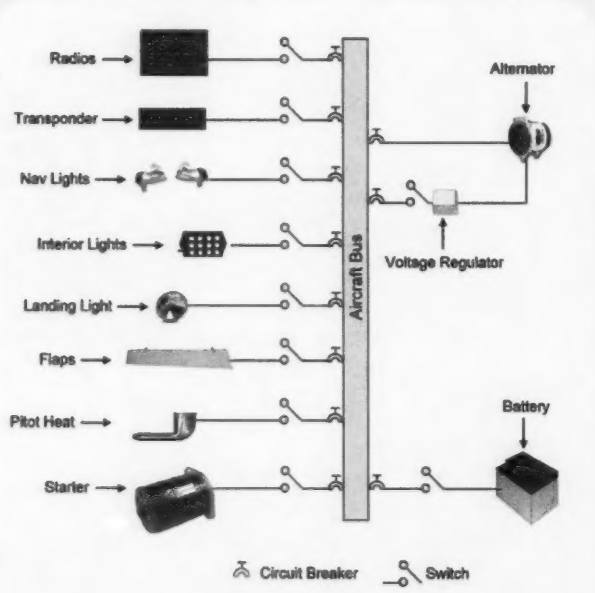


Fig. 1

What Happened to My Map?

While an inoperative landing light or flap failure can certainly add anxiety to your flight, a primary flight display (PFD) or multi-function display (MFD) screen that suddenly goes blank can be even more distressing. While these systems are much more reliable than the mechanical instruments they replace, as more aircraft migrate to glass-cockpit integration (some condensing nearly the entire instrument panel into a single display), pilots and mechanics will need to maintain a keen awareness of how to recognize and troubleshoot avionics component failures.

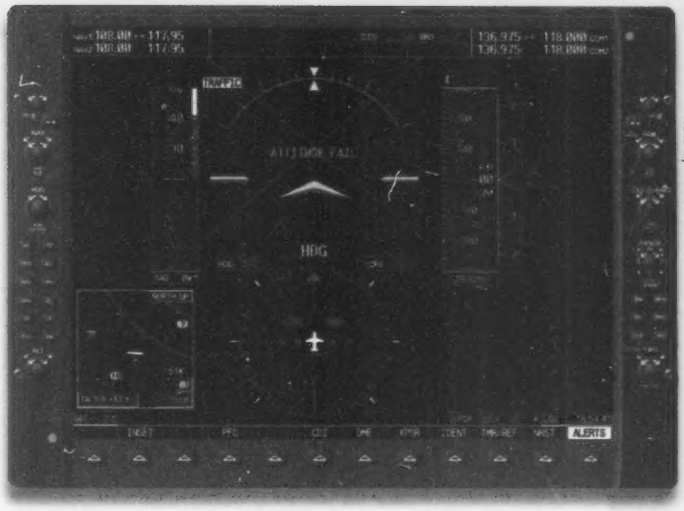


Photo by Susan Parson

Here is the good news. Today's display systems are designed to gracefully degrade when a failure occurs. If one display fails, the remaining display will revert to a mode that combines critical information from both displays on a single screen. This helps prevent the system from displaying hazardous or misleading information to the pilot. However, for mechanics to successfully troubleshoot these failures it is critical that they understand the system design as well as the role the individual components have in the overall system. For example, an air-data computer malfunction could result in the display's failure to present airspeed, altitude, vertical speed, outside air temperature, and true airspeed.

In some systems, a loss of information will be communicated to the pilot through a large red "X" over the inoperative indicator. In more advanced systems, a central maintenance system can provide detailed failure information that pinpoints the problem to a specific component or, in some cases, to an individual wiring problem. A component built-in test, known as "bite" capability, has become a highly reliable troubleshooting tool. However, don't let these advances fool you into thinking that avionics troubleshooting is now as simple as pushing a button. Knowledge of system operation and integration is essential, especially when there is a system problem and no associated component faults are found.

Because today's display systems are designed to eliminate hazardous or misleading information, some display problems may occur not as a result of a component failure, but because a system input is unavailable or invalid. For example, some systems may use valid GPS data as a critical input for the display of attitude, moving map, own-ship position, and heading. If the GPS input is not valid, the system will not display this information. Many situations external to the aircraft could cause the GPS signal to be invalid. These could range from planned GPS outages (typically covered by a NOTAM) to electromagnetic interference or sunspot activity.

Avionics display systems have evolved to provide more detailed information than ever, and much of it is crucial if we are to realize the improvements envisioned in the Next Generation Air Transportation System. Today's avionics mechanics have access to excellent troubleshooting tools that are integrated into the aircraft's avionics suite. This can provide quick and accurate problem identification. However futuristic and easy these systems are when they function properly, it is understanding the overall system operation, architecture, and integration that is the key to properly address advanced avionics problems.

— Tim Shaver

Tim Shaver is Avionics Maintenance Branch Manager in the FAA's Aircraft Maintenance Division. He is a commercial pilot and holds an A&P certificate.

A Simple Electrical System Problem in Flight

An electrical system problem in flight is indicated by either electrical accessories not working, or more seriously, an indication of electrical fire. An indication of an in-flight electrical fire will usually start with the smell of something burning or with visible smoke, which is caused by high current flow creating heat that melts wire insulation or other electrical components. An in-flight indication of an electrical fire is serious:

AIRPLANE + FIRE = BAD

The best course of action is to follow the manufacturer's emergency procedures immediately and get on the ground as soon as possible. The emergency procedures will generally start with using the master switch to turn off all electrical equipment. Next, the procedures may instruct you to turn off each piece of the electrical equipment, turn on the master switch, and then turn on individual pieces of equipment to isolate the failure. The switches allow us to isolate each of the electrical accessories (I told you we'd discuss why switches were important). Once you're on the ground, your local A&P mechanic can diagnose the problem while you're safely sitting in the FBO lobby sipping coffee.

The aircraft bus serves as a central point to connect all of the electrical components.

Luckily for us, electrical fires in flight are not that common. They happen, but the design of our aircraft electrical systems is intended to prevent electrical fires. The more common electrical-system problems in flight are individual component failures and supply-system (alternator and battery) failures.

Individual component failures are isolated and fairly easy to detect; you flip the switch and it doesn't work. The first place to look is to see if the circuit breaker associated with the component has popped. If so, the circuit breaker only requires resetting. However, as pointed out in the previously mentioned SAIB, resetting the breaker should be approached with caution and should only be done a limited number of times.

If there is an ammeter in the airplane, the ammeter should show an increase in output for the larger current-draw accessories, e.g., lights, pitot heat, and flaps, when they are selected. If there is no ammeter, or the component draws little current, then the failures may be a little harder to detect.

One component malfunction that is hard to detect in flight is pitot heat failure. This is because there is no immediate feedback of failure. The indication that pitot heat has failed will be the loss of airspeed indication in the presence of icing, but this is not the preferred method of failure detection. The loss of the airspeed indicator will require you to fly using the attitude indicator (pitch), the tachometer (power), and altimeter and vertical speed indicator (performance). I have a performance card for my airplane that gives me the associated performance indications. This is also known as flying by the numbers.

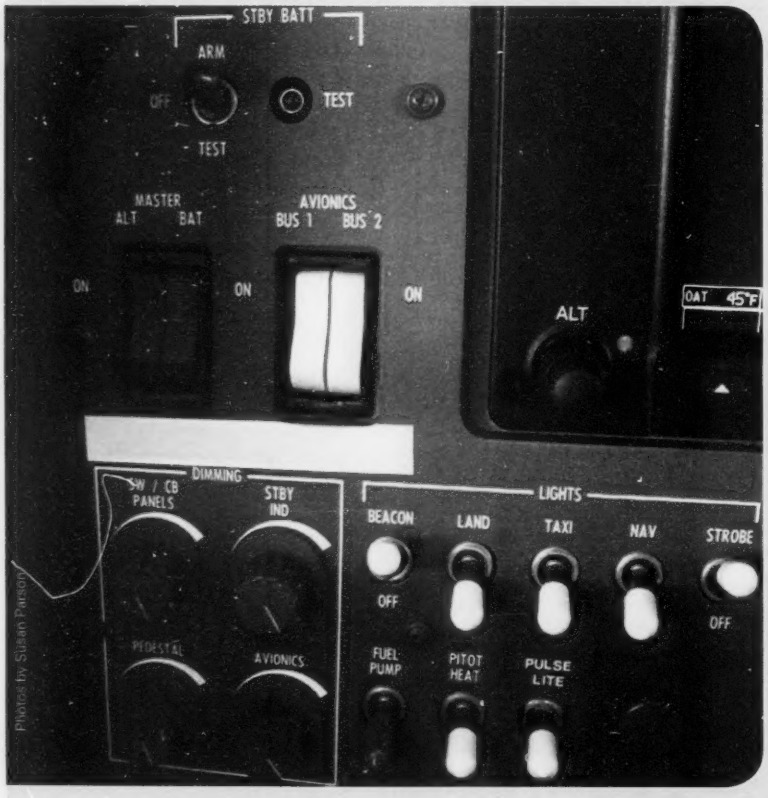


Photo by Susan Parson

Other Electrical Gremlins

Failures of the aircraft's lights are difficult to detect during the daylight hours, giving rise to the old joke that landing lights only fail at night. At night, light failures are easily detected as there is no immediate darkness abatement when the light switch is selected. I carry at least two flashlights and fresh replacement batteries. Flashlights stored in flight bags are known as convenient places in which to store dead batteries.

Radio failure is also easy to detect, because there is immediate feedback: You flip the switch, or press the push-to-talk switch, and it doesn't work. Radio failures manifest themselves by the loss of two-way communication and navigation. The *Aeronautical Information Manual*, chapter 6, section 4, Two-way Radio Communications Failures, covers the procedures for dealing with lost communication in flight. Navigation radio failures can be handled through the use of dead reckoning and pilotage. (Do you remember your student-pilot cross-country days?) I carry a portable GPS and communications radio as well as fresh replacement batteries.

Flap failures will likely be discovered during the landing phase of the flight. If your flaps fail to deploy, a no-flap landing is in your near future. Remember that your stall speed, approach speed, and landing distance will increase, so take a look at your Pilot's Operating Handbook (POH) to make sure you can get into your intended field with no flaps. A no-flap landing can easily be 30 percent longer than a normal landing with flaps.

Mind the Meter

One of the first indications that there is something amiss with the airplane's electrical supply system is an indication of a discharge on the ammeter. If the ammeter is not part of your regular cockpit scan, or there is no low-voltage annunciation in the cockpit, your first indication will most likely be blinking of the avionics and loss of the transponder when a demand is placed on the electrical system.

Earlier in my flying career, I experienced avionics blinking and transponder loss while flying in IMC. I was in a fairly new (to me) airplane that had a load meter instead of an ammeter, and there was no low-voltage annunciation in the cockpit. I first noticed a problem when I switched on pitot heat and the radios blinked.

There is an adage in flight test: If you touch something and it doesn't do what you intended, "un-touch" it. I un-touched the pitot heat and then ATC called me. It seems ATC had lost my transponder signal. I tried to respond and the radios blinked again when I pushed the push-to-talk switch.

I thought, "they're not supposed to do that and this is not good." I had time to receive one more call from ATC and acknowledge it before all of the electrons decided to take the afternoon off. Luckily, I had my portable GPS and I was able to get on the ground safely in VMC conditions.

It turns out that the cause of my electrical-system failure was that the generator brushes had fallen out of their holder (the generator was only 75 hours since overhaul) and the airplane had been running on battery alone. The load meter only shows a positive value, so there was no indication of battery discharge. When the battery was low enough, any additional demand on the electrical system resulted in an under-voltage on the bus and the blinking of the radios. The lesson learned: Have some way of checking the health of the electrical system, either a voltmeter or an ammeter, or preferably both. It also reinforced my belief in carrying portable navigation and communications radios. At the time of the failure, I did not have my portable communications radio; I have since taken care of that.

One of the first indications of something amiss with the airplane's electrical supply system is an indication of a discharge on the ammeter.

What Does This All Mean?

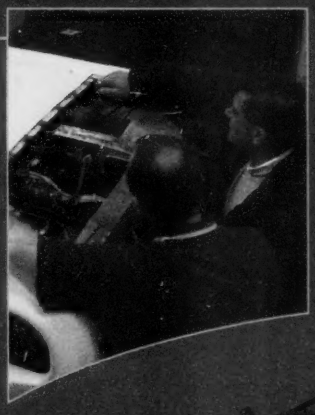
It pays to know what your electrical system looks like, how it functions, and what happens when it breaks. Doing a little homework will save you from getting a crash course in flight; no pun intended (actually, it was intended). Realistically, you do not want an in-flight electrical-system failure to be the first time you open your POH and read about the electrical system. Hit the books, get some dual instruction to blow the dust off of your emergency procedures, and get out and practice. Flying is easy when it goes right. But, it is when it doesn't go right, that your studies and training will pay off.

Peter Rouse is an aerospace engineer at FAA's Small Airplane Directorate in Kansas City, Mo. He is a 2,000-hour pilot and a certificated flight instructor. He has flown aerobatics in competition and is an active member of the International Aerobatic Club.

The FAA Wants You!

Attention pilots, mechanics, and avionics technicians:

Here is your opportunity to start a career in the exciting field of aviation safety. The FAA's Flight Standards Service is currently hiring aviation safety inspectors and is seeking individuals with strong aviation backgrounds in maintenance, operations, and avionics. Starting salaries range from $41,563 to $78,355, plus locality pay. Benefits include federal retirement and tax-deferred retirement accounts and health insurance.



Qualifications vary depending on discipline. For details, please visit http://jobs.faa.gov/. Under "All Opportunities" you can search by job series 1825 or title containing "inspector."

Start your application today.

TOM HOFFMANN

Hot Spots

Top 10 Signs You (or Your Airplane) May Be in Trouble

Top 10 lists: They are featured in late-night television jokes, rank the year's best movies, and even suggest the most influential minds among us. Just about everyone can appreciate a good top 10 list, even if only for entertainment value. But in the world of aviation, top 10 lists play a much more vital role. They help save lives.

Just ask Natalie Johnston, aviation safety analyst with the FAA's Office of Accident Investigation and Prevention, who's researching a list of particular interest to pilots—the top 10 causes of general aviation fatal accidents. With the help of several GA subject matter experts (SME), including FAA representatives from maintenance, operations, and the FAASTeam, Johnston is compiling a comprehensive list of contributing factors for each of these top 10 fatal accident causes. The goal of the list: Help us all understand why accidents happen, and more importantly, help us develop ways to prevent them.

A Fresh Perspective

"We're looking at information from all angles to dig deeper into the root causes of GA accidents," says Johnston, who along with the team of experts is reviewing data and narratives from hundreds of NTSB accident reports, and may, in the future, use data from the NASA Aviation Safety Reporting System (ASRS) and the FAASTeam. "Carefully examining the data sources, combined with the operational knowledge and personal experience of our SME team, helps us gain a distinct perspective on how to create a safer environment for the GA community."

For example, when reviewing an accident report on a pilot who lost control on landing during a stiff crosswind, there are several initial conclusions that can be drawn. Perhaps the pilot lacked training in crosswind landings or was flying an aircraft type different than what he/she normally flies. However, upon further review, you may learn that the pilot failed to get an adequate weather briefing and missed an opportunity to reassess landing options. Or, you may find that the pilot had been flying the final leg of 400-mile journey with dusk's hazy onset fueling an already safety-jeopardizing fatigue scenario.

Developing an accurate picture of contributing factors for an accident takes a collective effort. By carefully analyzing all possible factors in an accident and by holding them up to the light of firsthand experience and knowledge, it becomes clearer to see the beginning of a particular accident chain.

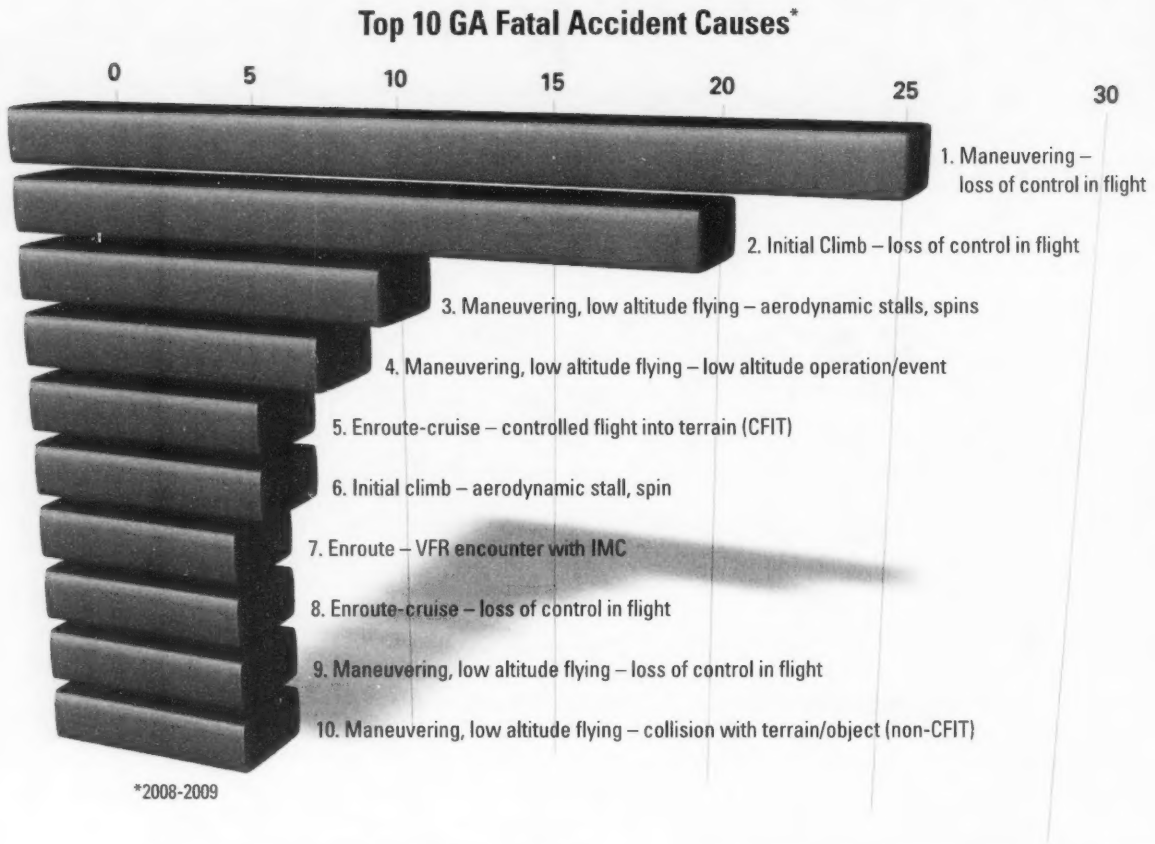
There's also the matter of ranking contributing factors. What sets the SME team's research apart from the way existing accident data is reported is how the team carefully identifies and scores the most common contributing factors for each top GA fatal accident cause. The scoring process is not intended to attribute a specific number to each factor, but rather to distinguish and separate the most important factors from those with the least probability of occurring. "In the end," says Johnston, "this will help us develop more effective mitigation strategies and pinpoint what pilots need to focus on to keep from being a statistic."

Looking at the top two causal factors, a common thread is apparent: loss of control in flight.

The Envelope, Please

While the final list of contributing factors is still being completed, here are the top 10 causes for GA fatal accidents as identified from NTSB accident-report data.

1. Maneuvering – loss of control in flight
2. Initial Climb – loss of control in flight
3. Maneuvering, low altitude flying – aerodynamic stalls, spins
4. Maneuvering, low altitude flying – low altitude operation/event
5. Enroute-cruise – controlled flight into terrain (CFIT)
6. Initial climb – aerodynamic stall, spin
7. Enroute – VFR encounter with IMC
8. Enroute-cruise – loss of control in flight


Top 10 GA Fatal Accident Causes*
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1. Maneuvering – loss of control in flight
2. Initial Climb – loss of control in flight
3. Maneuvering, low altitude flying – aerodynamic stalls, spins
4. Maneuvering, low altitude flying – low altitude operation/event
5. Enroute-cruise – controlled flight into terrain (CFIT)
6. Initial climb – aerodynamic stall, spin
7. Enroute – VFR encounter with IMC
8. Enroute-cruise – loss of control in flight
9. Maneuvering, low altitude flying – loss of control in flight
10. Maneuvering, low altitude flying – collision with terrain/object (non-CFIT)
*2008-2009

9. Maneuvering, low altitude flying – loss of control in flight
10. Maneuvering, low altitude flying – collision with terrain/object (non-CFIT)

Looking at the top two, there is a common thread: loss of control in flight. "When we studied loss-of-control accidents, during both the maneuvering and initial-climb phase, the top contributing factor was failure to maintain airspeed," says FAA Aviation Safety Inspector Donald Wood. A member of the SME team, Wood was somewhat surprised by the finding. "What this shows is a definite need for improving basic 'stick and rudder' skills, even among more experienced pilots."

Despite a few surprises, the group's findings are consistent with expectations and reveal important links in the GA accident-prevention chain. Airspeed control, pilot experience, preflight planning, and unusual-attitude recovery are all contributing factors that appear most frequently.

"By exploring these factors in more detail, we are seeing patterns that become helpful clues for pilots in similar situations," says Mel Cintron, manager of FAA's General Aviation and Commercial Division. "We look forward to collaborating with industry to review this data, along with data from the AOPA Air Safety Institute's well-established *Nall Report*. Our goal is to advance GA safety without stifling the spirit of aviation."

You will hear more about new safety initiatives in these pages and at the FAASTeam Safety Standdown on April 2, 2011. Mark your calendar and stay tuned for more information on GA accident causes, contributing factors, and, most importantly, prevention strategies.

Tom Hoffmann is associate editor of FAA Safety Briefing. *He is a commercial pilot and holds an A&P certificate.*

TOM HOFFMANN

Nuts, Bolts, and Electrons

Understanding the Service Difficulty Reporting System

What Can SDRS Do for You?

You are an AMT performing a routine annual inspection on a Cessna 172S. You suddenly discover a few flat spots on the aileron control cable. Using a rag, you snag some frayed wires around those spots, which indicate broken cable strands. Upon closer inspection, you discover some of the pulleys are causing the problem by not allowing the cables to roll properly. With the cables and pulleys replaced and operating properly, the job is done, right?

Not really. There is one more step you can take that will help alert other operators to the safety issue you discovered: submitting a Service Difficulty Report (SDR).

Since 1966, through the SDR system (or SDRS) FAA has collected data on failed aircraft parts and components. This reporting program has successfully improved safety for aircraft systems and components in the United States and around the world. By providing a communication link between FAA and the aviation community on specific aircraft mechanical issues, SDRS enables implementing corrective actions before there is an adverse impact on safety.

How Does SDRS Work?

The primary sources of this information include front-line mechanics, aircraft owners, and pilots, whose vigilant actions and attention to detail during inspections and repairs help assure mechanical reliability. The backbone of the system is the SDRS database maintained by FAA's Aviation Data Systems Branch in Oklahoma City. This database gets information from FAA Form 8010-4, Malfunction or Defect Report, commonly known as an SDR. SDRs should be filed whenever a system, component, or part of an aircraft, powerplant, propeller, or appliance fails to function in a normal manner. SDRs are also intended to collect information on flaws or defects that impair a part's proper function.

While paper versions of the form are accepted, FAA encourages the use of the online form available through the Internet Service Difficulty Reporting (iSDR) Web site (http://av-info.faa.gov/sdrx/). The iSDR site is more convenient to use and also provides a quicker method to report issues and solutions.

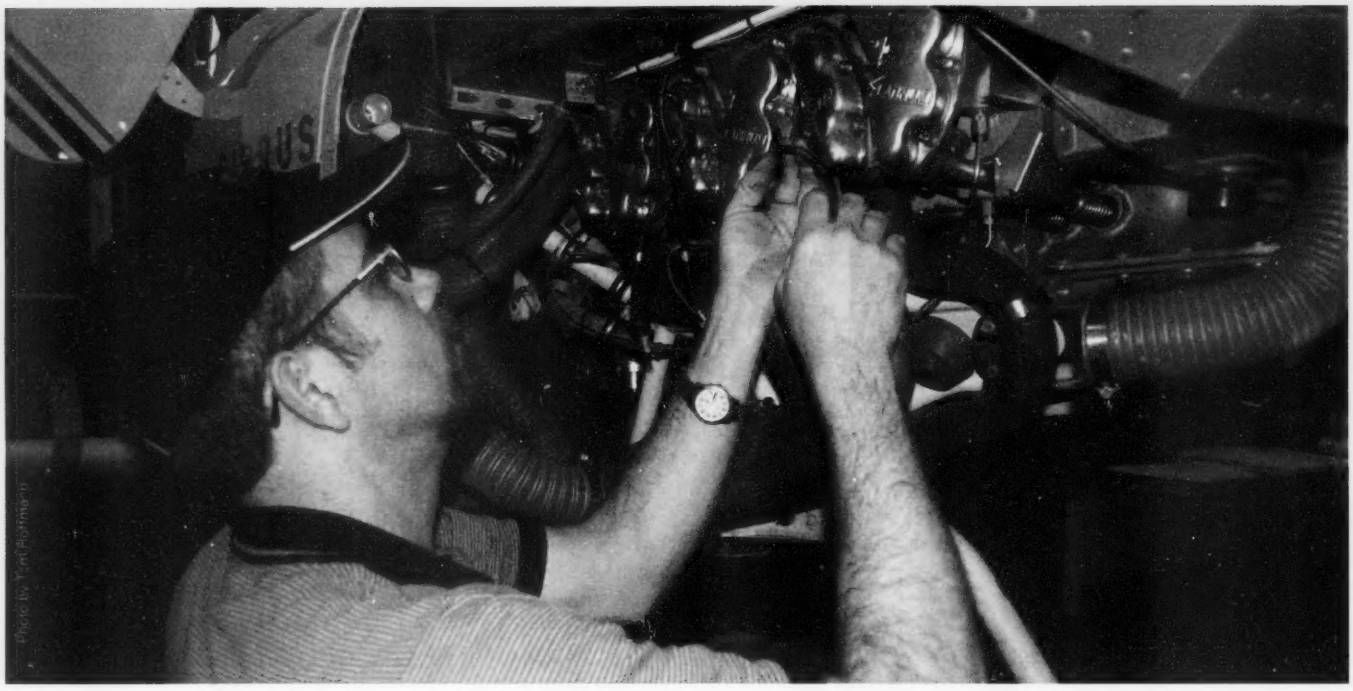
The FAA receives and uploads more than 80,000 SDR records each year. Even so, "the program is still underutilized," says FAA's SDRS Program Manager Pennie Thompson. She notes that only about 25 percent of reports are submitted by general aviation operators. "If embraced by the public and used properly, SDRs can be one of the most effective aviation safety tools available. Every report submitted helps identify potential problem areas, and alerts others to be on the lookout."

According to Thompson, future SDR development holds the key to the program's increased usage and effectiveness. Plans are underway to rebuild the database, which will provide more robust search and reporting capabilities. Also in the works is a revamped Web site aimed at providing a more streamlined and user-friendly interface, as well as a change in how SDR information is disseminated to the public. By leveraging the latest in mobile and social networking technology, you will be able to sign up for e-mail updates and/or "tweets" for any SDR that may affect your aircraft. As they say, "Stay tuned."

SDRs should be filed whenever a system, component, or part of an aircraft, powerplant, propeller, or appliance fails to function in a normal manner.

Who Uses the Data?

Nearly everyone in the aviation community, from NTSB to air carriers and GA operators worldwide, has an interest in the SDR program's information. Airmen can search the online database for items that may need special attention (especially if the aircraft logbooks are incomplete) or to identify past difficulties with a specific aircraft make or model. Queries can be refined by aircraft type, engine model, part number, or simply by a description of the problem. Click "Search Reports" from the main iSDR site to see a full list of query options.



The FAA also uses SDR data to analyze aircraft safety implications and to identify trends that may not be apparent regionally or to individual operators. Based on that information, the FAA may adopt new regulations or issue airworthiness directives (ADs) to address a specific problem. SDR information also helps FAA aircraft certification offices and product manufacturers evaluate the integrity and reliability of a product design as well as to track whether safety critical items break before they should.

Maintenance Alerts

One of the most visible products of SDR data is the Aviation Maintenance Alert (AC 43-16A), frequently highlighted in *FAA Safety Briefing*. Aviation Maintenance Alerts, updated monthly on www.faa.gov, provides the aviation community with a snapshot of the latest aircraft service difficulty information. A quick glance at any of these reports, which often include detailed photos, reveals the ubiquitous and random nature of aviation maintenance problems. Whether as subtle as a small crack found in a crankshaft, or as obvious as improperly-installed hardware on a flight-control component, the results often have catastrophic potential. Moreover, the pictures are proof that those things you think will never happen to you really do happen.

For example, let's look at a report on cracked magneto rotor gears submitted by a mechanic in the June 2010 Aviation Maintenance Alerts. Prior to reassembly of two Slick magnetos, the mechanic noticed numerous cracks on both magneto rotor gears. He found similar cracks on two new gears. This issue triggered a defect report to the parts manufacturer and underscores the fact that even brand new parts and components must always be inspected.

Remember to Submit

Over the years the SDR program has had an enormous impact on the aviation industry and has led to improvements in the design and maintainability of several aircraft and aircraft products.

Whether you are a mechanic, inspector, or pilot, you are the eyes of continued airworthiness and have an opportunity to improve safety every time you discover a problem. By submitting SDRs, you provide potentially life-saving data and become integral to preventing accidents.

Tom Hoffmann is associate editor of FAA Safety Briefing. *He is a commercial pilot and holds an A&P certificate.*

For More Information

FAA Aviation Maintenance Alerts
http://www.faa.gov/aircraft/safety/alerts/aviation_maintenance/

General Aviation SDR Submission Report
http://av-info.faa.gov/SDRX/SubmissionsGeneralAviation.aspx

SDR Search Page
http://av-info.faa.gov/SDRX/Query.aspx

Flight Forum

Come Fly With Me

Paul Greer's article "Come Fly With Me" in the September/October issue did a great job demystifying some of the rules regarding flying for compensation. But one very common situation deserves mention. The FAA has ruled that time logged is considered compensation. Therefore, the common practice of delivering an aircraft to or from maintenance or to a customer requires a commercial, or better, pilot certificate ... But a private pilot looking to gain time may not fly as a "favor" for an FBO, etc., without at least a commercial certificate.

Paul Werbin

Thank you for your compliment. Your comment definitely addresses another common scenario involving flying for compensation. A commercial pilot certificate would be required unless the pilot could operate the flight under the very limited exceptions specified in section 61.113(b) of Title 14, Code of Federal Regulations.

As I tried to show in my article, flying for compensation or hire can be a very complex area of the regulations. There are numerous situations where these issues can come into play (all of which, unfortunately, I couldn't address in the article). Often, the final determination as to whether a commercial pilot certificate or an operating certificate is required can hinge on a critical fact. As a pilot and flight instructor, I have seen these issues emerge numerous times and hope the article has served to raise pilot awareness.

— Paul Greer

Ask Medical Certification Clarification

In his September/October 2010 "Ask Medical Certification" column in FAA Safety Briefing Dr. Warren Silberman answered this question: "Can I get a medical with Type II insulin-dependent diabetes?" To clarify his answer, Dr. Silberman adds, "Once you are on insulin, you can only be certificated for a private pilot third-class medical certificate. However, if you are a Type II diabetic on oral medication—not insulin—you can get any class of medical certificate as long as you meet our criteria."

Coded Weather Data

Why are we still getting weather data in coded format?

Ronald Skamanich

According to Monica Bradford, acting manager, FAA Flight Services Safety and Operations Branch, presenting weather data in a coded format arose from the need to process meteorological information through automated means and transmit it rapidly between weather centers without regard to language. Meteorological codes developed by the World Meteorological Organization (WMO) can be processed by automated means and transmitted without regard to language. The standard format leads to increased efficiency throughout the world's aviation and forecasting communities. However, today's end user is not restricted to coded products. Most data providers now offer translation of the raw coded products into text, and some also offer graphical representations of observed and forecast data.

More on Weather

I'm the Meteorologist In Charge of the Oakland ARTCC Center Weather Service Unit (CWSU). I wanted to bring to your attention a Web site that has been developed by my office that is great for pilot weather situational awareness and for meteorologists alike.

The CWSU National METAR Maps (METAR in mouse-over): http://www.wrh.noaa.gov/zoa/mwmap3.php?map=usa

Ken Venzke
NOAA/National Weather Service
FAA Oakland ARTCC

Thanks for this. Readers, check it out. There are more resources, which we will highlight in future issues.

FAA Safety Briefing welcomes comments. We may edit letters for style and/or length. If we have more than one letter on a topic, we will select a representative letter to publish. Because of publishing schedules, responses may not appear for several issues. While we do not print anonymous letters, we will withhold names or send personal replies upon request. If you have a concern with an immediate FAA operational issue, contact your local Flight Standards District Office or air traffic facility. Send letters to: Editor, *FAA Safety Briefing*, AFS-805, 800 Independence Avenue, SW, Washington, DC 20591, FAX (202) 267-9463, or e-mail SafetyBriefing@faa.gov.

SUSAN PARSON

Editor's Runway

There I Was ...

When I was faced with a seemingly impossible challenge in the early days of my previous career as a State Department foreign-service officer, a more seasoned diplomat wryly urged me to remember that the worst times always make the best stories later on. It was cold comfort at the time, but I eventually recognized the truth in his observation. In fact, for many years since, I have had the best time regaling friends and colleagues with some of those "worst times" stories.

Pilots are pretty famous for doing the same thing. Much like fishermen who enthuse (and *maybe* exaggerate just a bit) about "the one that got away," pilots engaged in the sport—or is it an art?—of hangar flying enjoy sharing "there I was ..." stories of narrow escapes, derring-do, and (of course) stupid pilot tricks perpetrated by all those other people.

Trading tales is fun, but good hangar flying stories can offer a lot more than entertainment.

Stories Stick

Trading tales is fun, but good hangar flying stories can offer a lot more than entertainment. In their 2007 book *Made to Stick*, authors Chip Heath and Dan Heath note the power that stories have on human beings:

> *Stories illustrate causal relationships that people hadn't recognized before and highlight unexpected, resourceful ways in which people have solved problems. ... The story's power, then, is twofold: It provides simulation (knowledge about how to act) and inspiration (motivation to act). ... A* credible *idea makes people believe. An* emotional *idea makes people care. ... The right stories make people act.*

That is why we aim to structure many of this magazine's articles around stories of, for, and by real pilots and mechanics—people like us whose experience can help us operate more safely, but also teach us ways to avoid the worst-times abnormal and emergency situations that generated their "there I was" stories. The AOPA Air Safety Institute takes a similar approach with its Real Pilot Stories series. As the AOPA/ASI Web site observes, listening to pilots involved in a flight that went bad can help the rest of us become better pilots.

Read and Heed

Stories are a great way to convey information, but we humans sometimes have a way of hearing without really learning. As I have regularly confessed in some of my weather presentations for pilot safety seminars, I once found myself heading for a continued-visual-flight-rules-into-instrument-meteorological-conditions situation because I had allowed external pressures to overpower my situational awareness and dominate my thinking. Having previously read and heard dozens of stories by pilots who made that very mistake, I was shocked to find myself so close to doing exactly what they had done. I promised myself then that I would henceforth endeavor to read and heed, not simply review and then later redo my own version of others' mistakes.

One key to learning from a story is to imagine yourself in the other pilot's seat, and mentally accompany him or her through the experience. It can be satisfying to focus instead on how you would *never* be as stupid as that other pilot—I admit I've been guilty of such thoughts. However, I can benefit even more if I try to understand the chain of decisions and actions, and then use the story to help me find and fix the weak links in my own decision-making chain.

Learning from others is a powerful way to minimize your chances of getting into an abnormal or emergency situation, and to maximize the likelihood of safe flights and happy landings.

Susan Parson is a Special Assistant in the FAA's Flight Standards Service. She is an active general aviation pilot and flight instructor.

JAMES WILLIAMS

FAA Faces

Dave Swartz

A Passion for Aviation Safety

"I learned a lot from my crash."

Pilots don't generally talk about their less successful flights, but Dave Swartz is determined that fellow aviators have an opportunity to learn from his mistakes. If the name seems familiar, it may be because you have heard Swartz, a popular speaker on the aviation-safety circuit, talk about aircraft-performance planning. And, he wrote about his crash in this magazine's May/June 2009 issue ("More than Math: Understanding Performance Limits").

Swartz started flying at age 15. Like many pilots native to Alaska, he grew up flying on skis and floats, and continues to enjoy both activities. To earn a living (and pay for flying), Swartz became an aeronautical engineer, eventually earning a Ph.D. from the University of Utah. His early career included positions at the biggest names in aviation, including Piper Aircraft and Boeing.

When Swartz joined FAA he was an Aircraft Certification Service composite-materials specialist in Renton, Wash., and worked on the certification team for what was then the Lancair *Columbia*, now the Cessna *Corvalis* series. "The *Columbia* project was one of my favorite FAA experiences," Swartz says. "Because of my experience with composites, I was one of the more qualified FAA engineers for this particular job. It was rare for the Renton office to work on a GA certification project and I loved having that opportunity."

Swartz eventually returned to Alaska with his wife (also an FAA employee) as a senior aircraft safety engineer, and became the proud owner of a 1949 Aeronca Sedan that he likes to fly when he is not working. When it comes to aviation safety, though, Swartz is always working. Both as FAA safety engineer and as pilot and aircraft owner, Swartz shares a passion for aviation safety with his fellow Alaska pilots. "We all have that passion, because all of us have lost friends and family members to aviation accidents.

"If your engine fails in Kansas, you can land on a road," Swartz adds. "If you're over the Alaska Range, though, you are likely to die if you're flying an aircraft with wheels. Even with skis, the outcome can be deadly."

Swartz is quick to emphasize that the risks that can come from flying in Alaska are not without rewards. "I routinely fly the canyons near Denali, the tallest mountain in North America, and the country is beautiful. The area between the mountains and the glaciers can be deadly on a bad day, but it's gorgeous on a good one."

To reap the benefits of the good days, Swartz does what all pilots should do, regardless of where they fly: "I know what the hazards are and I choose to accept certain risks. But, I do everything I can to mitigate those risks."

"I do everything to mitigate risks."

As Swartz well knows, one of the risks, even for the most safety-minded pilot, is to guard against complacency. "Accidents don't have just one causal factor," Swartz explains. "But, many of the leading factors center on the pilot and planning."

"In the case of my accident, I'm an engineer who occasionally does performance calculations for a living, so I knew I did them right." Yet, that unfortunate time he did not account for the tailwind he did not know he had.

That experience, combined with his safety passion and skill with performance calculations, come together to bring him to the podium at aviation events and seminars. Swartz's candor and commitment has helped many others recognize the need to understand the calculations they make, which is a winning formula.

James Williams is FAA Safety Briefing's *assistant editor and photo editor. He is also a pilot and ground instructor.*

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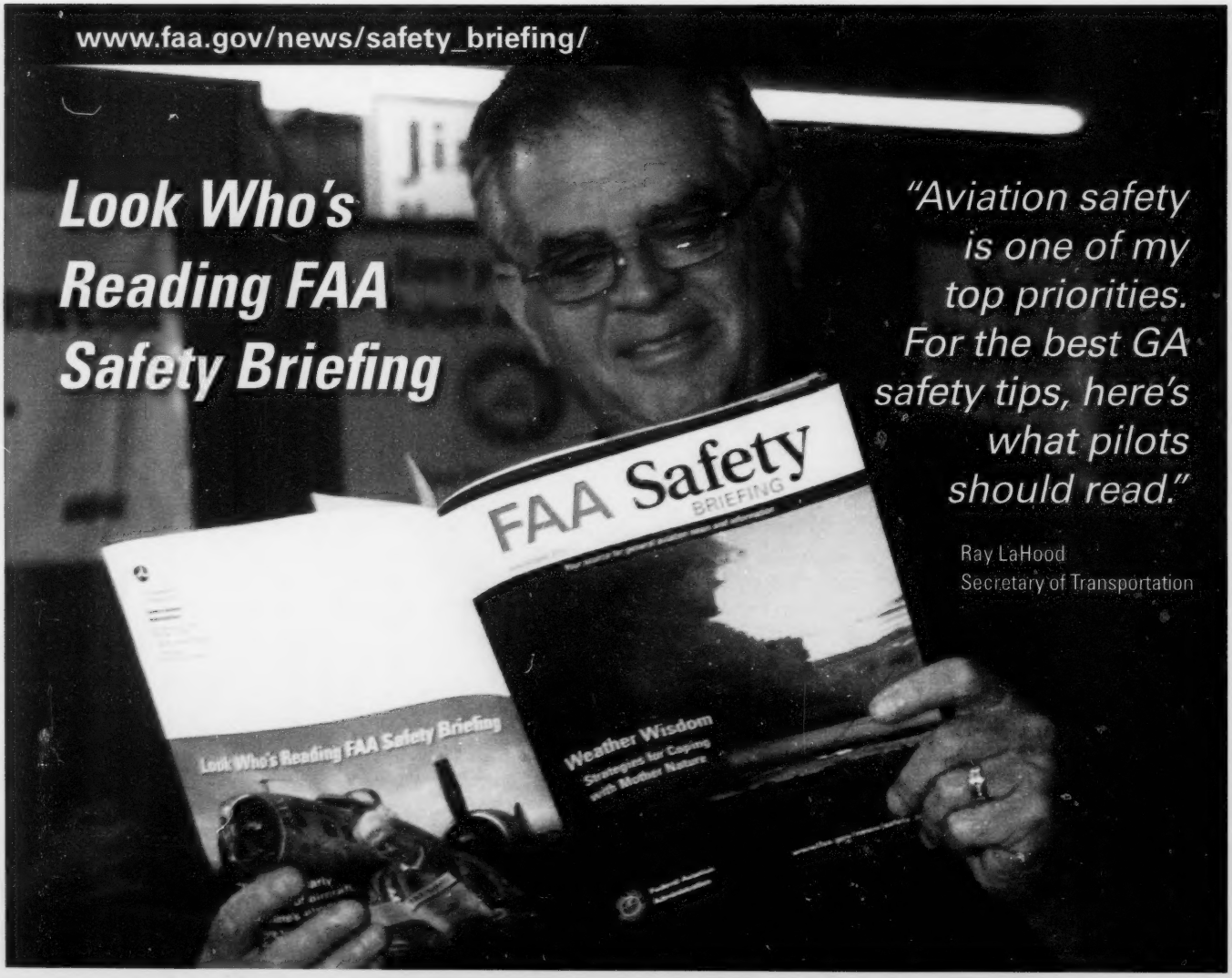
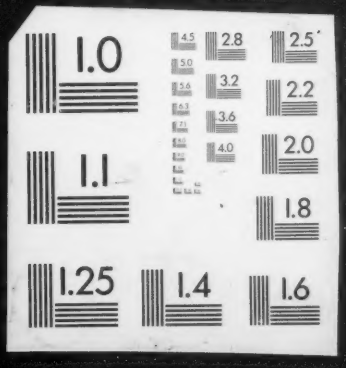

www.faa.gov/news/safety_briefing/
Look Who's Reading FAA Safety Briefing
"Aviation safety is one of my top priorities. For the best GA safety tips, here's what pilots should read."
Ray LaHood
Secretary of Transportation
FAA Safety
BRIEFING
Look Who's Reading FAA Safety Briefing
Weather Wisdom
Strategies for Coping with Mother Nature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